DEMAND FOR FOOD COMMODITIES IN THE DOMINICAN REPUBLIC AND SOME IMPLICATIONS FOR NUTRITIONAL POLICIES

BY

MARINO CHASLATTE

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DEMAND FOR FOOD COMMODITIES IN THE DOMINICAN REPUBLIC AND SOME IMPLICATIONS FOR NUTRITIONAL POLICIES

By

Marino Chanlatte

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The nutritional problem has been identified as one of the most important development issues in the Dominican Republic. The nutritional status and other development problems associated with food consumption projections and the effect of food demand on trade are of major concern for the Dominican policymakers. This study developed a full matrix of demand elasticities for food commodities at a disaggregated level. The primary concern of this study was to develop these estimates and to demonstrate their usefulness in evaluating nutrition and food consumption policies.

Coefficients estimated from [illegible] demand equations were used to estimate an elasticities matrix. These demand equations were estimated using the tobit model and data from a national household consumption survey. This matrix was comprised of 996 price and income elasticities for 30 food commodities and groups of commodities, the all-food aggregate, and one nonfood group. Family size elasticities were also estimated. In general, the estimated cross and direct price elasticities for most of the commodities were within a logical range.

The effects of changes in prices and income on calorie and protein intake were estimated using the elasticities.

An increase of 10 percent in the price of rice, and also in income, were postulated, and the change in calorie and protein intake were estimated.

An analysis of the effect of a change in income and prices on the consumption and import goals of the Secretariat of State for Agriculture (SEA) crop programs was undertaken for rice, red beans, and cassava. The conclusions were that, in the three cases, the projections of the SEA's operative plan could be improved by making use of price and income elasticities.

CHAPTER I

INTRODUCTION

Problem Setting and Objectives

One of the main objectives of the [illegible] development plans in the Dominican Republic is to improve the nutritional status of the lower income groups of the population (Secretaria de Estado de Agricultura [illegible] SEA, 1979, Oficina Nacional de Planificación, ONAPLAN, 1980a).

To make explicit the importance that the government has placed on this objective, and the means to achieve it, ONAPLAN published a detailed study on the nutritional situation of the country (ONAPLAN, 1978) and later presented a paper giving basic suggestions for a national policy on food and nutrition (ONAPLAN, 1980b). This paper led to discussions and to the current formulation of food and nutrition plans.

Some of the proposed instruments to cope with the nutrition problem are increased income per capita, the redistribution of income, and increased food production. Along with these instruments, the plans being formulated also call for greater self sufficiency (fewer imports) of basic food crops

Some measures have been taken to increase the income of the low-income groups. The minimum wage for agricultural workers was increased from $2.50 for 8 hours of work to $3.50 (Law 25 of 1979, Quezada 1981, p. 39). In other sectors of the economy, minimum wages were raised to $125.00 per month (Law 45 of May 25, 1979). Also, an increase of 10 percent was established in the wages and salaries of all the workers who were earning $300.00 or less. Income taxes were also modified to favor the low-income groups (Law 39, May, 1979, ONAPLAN 1980a, p. 32).

Regarding production goals, the SEA's Operative Plan for 1982 contains specific production and consumption goals for 22 products along with a package of projects and programs to reach these production goals.

ONAPLAN has pointed out the need to estimate the effect of changes in income among income groups on food consumption and the impact of increased income on the nutritional situation of each income group. This agency also called for the study of the effect of food policy on production and trade (ONAPLAN 1980b, p. 13).

Some work has been done to estimate income elasticities (ONAPLAN 1980b). The range of income was divided into four income strata for 22 food commodities. Using data from the 1969-70 Central Bank survey on household income and expenditure, the change in expenditures on food between two income groups was used to approximate a global income elasticity. With this arc elasticity and three postulated income distributions, ONAPLAN projected the consumption of food products and compared consumption with the production goals of food crops from SEA's Operative Plan to analize the need for food imports (ONAPLAN 1980b, p. 38-39).

A more sophisticated measure of the effect of income on food expenditure is needed to improve projections for policy purposes. The effects of prices on the food consumption and family budgets were not measured. Estimates of the direct and cross price elasticities are needed to study the effect of the change in the price of one product on the consumption of that product and on the other products being considered.

Thus, estimates of income and price elasticities are necessary to analyze the effect of income and price changes on the consumption of food commodities and, through the nutrient characteristics of each commodity, to calculate the impact on the nutrition levels of different income groups. It is also possible to use such estimates to analyze the effect of government policies aimed at redistributing or increasing incomes on the food price level and food imports.

The general objective of this study was to analyze the effectiveness and consistency of government food policies concerning income and price changes, and basic food imports.

The study was partial in the sense that it focused mainly on the demand side. The impact on food imports (production deficits) was based on various assumptions about the effect of domestic policies on the supply side.

Specific objectives of the study were as follows:

1--to estimate a full matrix of demand elasticities of disaggregated food commodities from cross sectional data,

2--to estimate expenditure elasticities of selected food commodities using a new method that provides more flexible coefficients,

3--to estimate the effect of household size on consumption of food in the Dominican Republic,

4--to estimate the potential effects of changes in prices and income on the nutrition level of the population of the Dominican Republic, and

5--to analyze food and nutritional policies with the information generated and to determine the consistency or inconsistency of the food policy instruments proposed.

Characteristics of the Dominican Economy

The Dominican Republic occupies the eastern [illegible] of the Island of Santo Domingo (Figure 1.1). It encompasses an area of 18,900 square miles and had an estimated population of 5.4 millions in 1979, a density of about [illegible] people per square mile (ONAPLAN, 1980a, p. 1). It has a 1,000-mile coast line, and a 193-mile common border with Haiti.

Its relatively high population density (compared with other Latin American countries) is of concern since only 44 percent of the total area is agricultural land (22.4 percent crop land and 21.6 percent pastures). Forest land and reserves comprise 54.4 percent and the rest consists of lakes and non-usable land (ONAPLAN, 1980a, p. 1).

Even though productivity is low, the agricultural sector has played, and must continue to play, an important role in the economic development of the country.

In 1970, 55.5 percent of the labor force was engaged in agriculture; its average productivity (value added per person employed) was only $506. In comparison, 7.6 percent of the labor force was engaged in manufacturing and had an average productivity of $2,646 (Table 1.1).

The shares for agriculture, manufacturing, and commerce, which account for more than half of the GDP, declined during the period 1976-79. Government,

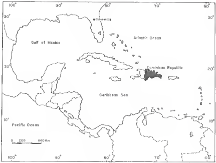


Figure 1.1. Location of the Dominican Republic

Table 1.1 Employment, value added and value added per person employed in the Dominican Republic, by sectors, 1970

Sector	Employment Number	Employment Share	Value added	Value added
		percent	millions of 1962 DR $	percent
Agriculture	594,924	55.5	310.2	23.3
Mining	927	--	18.1	1.4
Manufacturing/Industry	81,619	7.6	216.0	16.7
Power	2,398	0.2	19.7	1.5
Construction	30,130a/	2.8	64.2	[illegible]
Government	68,725a/	6.4	137.4	[illegible]
Services	293,784	27.4	533.4	[illegible]
Total	1,072,784	100.0	1,290.0	100.0

Table 1 (continued)

Sector	Value Added per Person Employed
	1962 DR $
Agriculture	506
Mining	19,525
Manufacturing/Industry	2,646
Power	8,215
Construction	2,131
Government	1,999
Services	1,186
Total	1,203

a/ Persons employed in public works excluded from gover[illegible] included in construction.

Source: World Bank. Dominican Republic--Its Main Economic Development Problems. Washington, D.C., December 1978, p. 11.

[illegible] the fastest growth rate per year ([illegible], [illegible], and 1.8 percent, respectively) since [illegible] (Table 1.[illegible]). Food production has lagged behind the population growth rate. Since most of the cultivable land is already being used, increased agricultural output will have to come from improved yields (World Bank, 1978, p. 1[illegible]).

Real income per capita in the Dominican Republic decreased from $489 in 1976 to $481 in 1979 (Banco Central, Dec. 1981, p. 199), and income distribution in 1976-77 showed that 50 percent of families with the lowest income receive only 18.5 percent of the total income. Income distributions for the country and for the urban and rural areas are depicted by the Lorenz curves presented in Figure 1.2.

In 1976-77, 50 percent of the population had a per capita income below the poverty level, and the percentage was higher in the rural areas than in the cities (Quezada, 1981, p. 3).

The decrease in income per capita along with the uneven distribution of income has worsened the nutritional condition of the population. Consumption of calories per person decreased 9.2 percent from 1973 to 1977, and overall about 75 percent of the population consumed less food than is needed to fulfill the minimum nutritional requirements (ONAPLAN, 1980b, p. 2).

Table 1.2. Gross domestic product in the Dominican Republic in 1976 and 1979, the change between those two years, and the equivalent compound rate of growth, by sectors

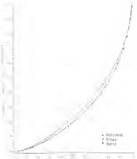
Sector	Value 1976	Value 1979	Shares 1976	Shares 1979
	millions of 1970 DR $		Percent	
Agriculture	429.2	461.7	17.6	16.8
Mining	146.7	146.5	6.0	5.3
Manufacturing	457.4	504.8	18.6	18.4
Construction	153.2	184.0	6.3	6.7
Commerce	414.0	455.5	16.9	16.6
Transport	166.7	195.8	6.8	7.1
Housing	156.8	186.0	6.4	6.8
Government	189.9	236.1	7.8	8.6
Other a/	329.0	375.7	13.5	13.7
Total	2,442.9	2,746.1	100.0	100.0

Table 1. (Continued)

Sector	[illegible]			
	RD$ millions of 1970	Percent of total growth	Rate of growth	Compound Rate of growth per annum (percent)
Agriculture	32.6	10.7	7.6	2.5
Mining	-0.2	--	--	--
Manufacturing	47.4	15.6	10.4	3.3
Construction	30.8	10.2	20.1	6.3
Commerce	41.5	13.7	10.0	3.3
Transport	29.1	9.1	17.5	5.5
Housing	29.2	9.6	16.6	5.9
Government	46.2	15.2	24.3	7.6
Other[a]	46.7	15.4	14.2	4.5
Total	303.2	100.0	12.4	4.0

[a] Includes electricity, finance, communications and other services

Source: Banco Central de la Republica Dominicana. Boletin Mensual, Dec. 1981. Santo Domingo.



[illegible] 2 Family [illegible] Dominican Republic, 1976-7[illegible]

The pattern of development of the Dominican economy is characterized by the dominant role of the foreign sector. Agricultural products and some minerals are exported, and manufactures, oil, and capital goods are imported. In 1979, the value of exports represented 16 percent and imports 21 percent of the GDP (Banco Central, Dec. 1981).

Although the share declined from 91.2 percent in 1966 to 70.7 percent in 1976, agricultural exports still represent the bulk of Dominican exports. The share lost by agriculture has been gained by mineral products (Table 1.3). In 1980, for example, the four leading minerals (bauxite, ferronickel, gold, and silver) accounted for 39.4 percent of the total exports, and the four leading agricultural exports (sugar, coffee, cocoa, and tobacco and their by-products) accounted for more than 50 percent (Banco Central, Dec. 1981, p. 129).

Intermediate goods have been dominant among imports (29.8 percent in 1974), followed by consumer goods (26.8 percent) and capital goods (23.9 percent). Fuels and lubricants showed the fastest growth rate among all imports --a 68.3 percent average annual growth from 1970 to 1974 (Table 1.4)

It is interesting to observe the increase of the imports of foodstuffs and crude oil from 1973 to 1977. The increase in crude oil imports was estimated at $145.68

Table 1.3 Proportion of exports from the Dominican Republic by commodity, [illegible]

	1966	1967	1968	[illegible]	[illegible]	[illegible]
			Percent			
Agricultural Products (Processed and Unprocessed)	91.1	90.2	[illegible]	89.0	89.6	90.1
Sugar and By-products	58.9	60.3	56.1	53.7	54.3	60.2
Raw Sugar	(51.4)	(52.4)	(50.7)	(47.9)	(48.5)	(54.8)
Furfural	(2.7)	(2.6)	(1.8)	(2.5)	(2.4)	(2.7)
Molasses	(2.9)	(3.5)	(2.9)	(2.6)	(3.2)	(2.7)
Other	(1.8)	(1.8)	(0.7)	(0.7)	(0.2)	(--)
Cocoa and By-products	8.1	7.7	8.5	10.9	9.2	5.4
Cocoa Beans	(7.9)	(7.4)	(8.3)	(10.7)	(9.0)	(5.2)
Chocolate	(0.2)	(0.3)	(0.2)	(0.2)	(0.2)	[illegible]
Other	(--)	(--)	(--)	(--)	(--)	[illegible]
Coffee	15.4	10.9	10.9	[illegible]	[illegible]	[illegible]
Tobacco and By-products	4.8	6.7	6.9	[illegible]	[illegible]	[illegible]
Bananas	0.6	--	0.1	0.1	0.1	--
Meat	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other	3.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mineral Products (Processed and Unprocessed)	8.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bauxite	7.5	[illegible]	[illegible]	[illegible]	7.1	6.6
Ferronickel	--	--	--	--	--	0.2
Other	0.5	[illegible]	[illegible]	[illegible]	0.5	0.5
Manufactures, Re-exports and Other	0.8	[illegible]	[illegible]	[illegible]	2.8	2.6
Total Commodity Exports	100.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 1.3: Continued

	1972	1973	1974	1975	1976
			percent		
Agricultural Products (Processed and Unprocessed)	78.1	75.3	80.0	81.2	70.7
Sugar and By-products	50.7	46.6	54.7	66.5	40.5
Raw Sugar	(45.9)	(42.3)	(50.9)	(62.7)	(35.5)
Furfural	(2.5)	(1.8)	(1.3)	(2.0)	(2.9)
Molasses	(2.1)	(2.3)	(2.0)	(1.6)	(1.8)
Other	(0.2)	(0.2)	(0.5)	(0.2)	(0.3)
Cocoa and By-products	5.3	5.5	7.5	3.2	7.0
Cocoa Beans	(4.6)	(4.4)	(6.9)	(2.8)	(6.3)
Chocolate	(0.1)	(0.1)	(0.2)	(0.1)	[illegible]
Other	(0.6)	(1.0)	(0.4)	(0.3)	[illegible]
Coffee	8.6	10.5	7.2	4.8	14.1
Tobacco and By-products	8.3	6.9	6.2	4.0	[illegible]
Bananas	0.3	0.3	0.2	0.2	[illegible]
Meat	1.9	2.3	1.4	0.5	[illegible]
Other	3.0	3.2	2.8	2.0	[illegible]
Mineral Products (Processed and Unprocessed)	17.9	22.4	17.6	16.2	[illegible]
Bauxite	4.3	3.3	2.8	1.7	2.2
Ferronickel	13.5	18.9	14.6	11.4	15.5
Other	0.1	0.2	0.2	3.1	7.8
Manufactures, Re-exports and Other	4.0	2.3	2.4	2.4	3.8
Total Commodity Exports	100.0	100.0	100.0	100.0	100.0

Source: World Bank. Dominican Republic--Its Main Economic Development Problems; Washington, D.C., 1978.

Table 1.4. Imports into the Dominican Republic by major categorie
1967-74

	1967	1968	1969	1970	1971
	millions of US $				
Total Import Goods[a/]	171.3	200.8	221.9	295.0	340.1
Consumer Goods	48.6	62.8	59.8	76.9	88.7
Food	31.5	44.3	38.5	44.3	53.6
Other	17.1	18.0	21.3	32.6	35.1
Fuels and Lubricants	12.8	13.8	18.1	19.3	24.8
Intermediate Goods	59.8	71.3	77.0	104.6	113.0
Capital Goods	50.1	52.9	67.0	94.2	113.6
	percent of total import goods				
Total Import Goods	100.0	100.0	100.0	100.0	100.0
Consumer Goods	28.4	31.3	27.0	26.1	26.1
Food	18.4	22.3	17.4	15.0	15.8
Other	10.0	9.0	9.6	11.1	10.3
Fuels and Lubricants	7.5	6.9	8.1	6.5	7.3
Intermediate Goods	34.9	35.5	34.7	35.5	33.2
Capital Goods	29.2	26.3	30.2	31.9	33.4

[illegible], Continued

	[illegible]	[illegible]	[illegible]	Average [illegible] Growth [illegible]
	millions of US $			
Total Import Goods[a]	382.0	[illegible]	796.4	28.2
Consumer Goods	104.3	124.9	213.6	28.1
Food	59.2	74.2	133.7	31.8
Other	45.1	50.7	79.9	25.1
Fuels and Lubricants	46.7	48.5	155.0	68.3
Intermediate Goods	120.3	145.9	237.5	22.8
Capital Goods	110.7	129.2	190.3	19.2
	percent of total import goods			
Total Import Goods	100.0	100.0	100.0	
Consumer Goods	27.3	27.9	26.8	
Food	15.5	16.6	16.8	
Other	11.8	11.3	10.0	
Fuels and Lubricants	12.2	10.8	19.5	
Intermediate Goods	31.5	32.5	29.8	
Capital Goods	29.0	28.8	23.9	

[a] Based on UN Trade Publications. Includes OECD countries and Venezuela. This source is adjusted for petroleum, transport vehicles and wood. These totals will not necessarily coincide with total imports used in balance of payments which are based on Direction of Trade imports from trading partners.

Source: World Bank. Dominican Republic--Its Main Economic Development Problems. Washington D.C., 1978.

millions For the same period, the increase [illegible] imported was estimated at $40.[illegible] millions (World [illegible] p. 146). These two items added considerably to the [illegible] deficit of $557.8 millions in 1980--10 percent of the [illegible] (Banco Central, Dec 1981, p 129).

Between 1978 and 1980 prices were inflationary. The consumer price index increased 7.1 percent in 1978, 9.2 percent in 1979, and 16.7 percent in 1980 (Banco Central, Dec. 1981, p. 155). After a jump in the rate of inflation between 1979-80, prices were still increasing in 1981 but at a more moderate rate. During the 12-month period from November 1980 to November 1981 the consumer price index increased 6.3 percent and this slower rate continued through 1982.

The impact of the increase in prices has been different in the rural and urban areas. In 1980, the urban price index increased by 18.4 percent, that is, 1.6 percent more than the national increase. The rural price index increased by 15.4 (Banco Central, Dec. 1981, p. 155).

Looking at the increase in the consumer price index by income strata, it is observed that in 1980 the index for the $300 to $400 income stratum showed the smallest increment (13.8 percent). The index for all other strata (above and below) grew relatively equally.

The change in the consumer price index by groups of commodities was 15.4 percent for food, alcohol, and tobacco, 10.2 percent for housing, 20.4 percent for clothing, and 31.8 percent for others (Banco Central, Dec. 1981, p. 157).

Plan of Dissertation

Chapter II is used to present the traditional uses of household budget surveys and their applications to estimating Engel curves. This chapter is also used to review the literature within the theoretical framework applied in this study. This review included consumer theory and demand analysis, and applications of cross-sectional data in demand estimations.

The methodology applied in this study is described in Chapter III, including the use of the restrictions of consumer theory, the models applied, and the estimation procedure. Steps followed to calculate the elasticities matrix are also explained in this chapter. In the last part, the method used to calculate the effect of prices and income changes on calorie and protein intake is discussed.

The coefficients estimated are discussed in Chapter IV along with the presentation and discussion of the full matrix of demand elasticities and family-size elasticities. A final comment is made about the results of the new method of estimating Engel elasticities.

The [illegible] for policy are discussed in Chapter V, showing the effects of changes in prices and income on the calorie and protein intake. The last part of this chapter presents the implications of changes in income and prices for consumption and import goals.

Finally, Chapter VI gives the summary and conclusions. Limitations of this work are identified and some suggestions for further research are offered.

CHAPTER II

THEORETICAL FRAMEWORK AND REVIEW OF LITERATURE

In applied demand analysis there has been concern about the theoretical plausibility of empirical demand parameters. One way to proceed in order to ensure the theoretical validity of the estimated demand model is to specify a utility function. The demand functions to be estimated can then be derived from the first order conditions obtained when maximizing the utility function subject to the budget constraint of the consumer. A disadvantage of this approach is the requirement of specifying well-behaved utility functions and the derived demand equations which result may be too complicated to be estimated due to the number of parameters or to nonlinearities. The other approach is more pragmatic and leads to the direct specification of demand functions with causal variables that are believed to capture the behavior of the consumer.

In reviewing the literature, an attempt was made to fill the gap between the theory of consumer behavior and empirical demand analysis. Emphasis was upon those studies using cross section [illegible] income and price elasti[illegible] of demand.

Household Budget Surveys

Household budget surveys have been [illegible] estimate income-consumption relationships and some [illegible] have been made to estimate price elasticities of demand. This kind of survey provides data indicating all expenditures on consumer goods and services made by individual families. A basic objective of the budget survey is to obtain the percentage budget share of all consumption items to be used as weights in the official cost of living index (Phlips 1974, p. 101-102). These cross-sectional data can be used to estimate Engel curves, which express the expenditure on a good as a function of income, i.e.,

$$E_i = p_i q_i = f_i(y) \qquad , i=1,..,n$$

where p represents price of good i, q represents quantity of good i, y represents income and n is number of goods

The fact that prices are (almost) constant is used to isolate the influence of income and the simultaneous variation of both prices and income encountered in time series analysis is avoided. However a cross section does not automatically satisfy the assumption of a single given utility function, because the preference ordering may change from family to family (Phlips 1974, p. 103) To overcome

[illegible]

families that have different incomes which are as homogeneous as possible with respect to such things as family sizes and profession.

Phlips adds that to ensure the theoretical plausibility of estimated Engel curves the [illegible] restrictions of demand theory must be satisfied. All the price derivative restrictions of demand theory (i.e., homogeneity, symmetry, negativity of the own substitution effect) disappear because prices are constant (Phlips [illegible], p. 105). The only restriction that remains is the adding-up condition, i.e., that

$$\Sigma f_i(y) = y$$

or similarly

$$\Sigma(dE_i/dy) = 1 \quad ,$$

the sum of the marginal propensities to consume (or the marginal budget shares) has to be equal to one at all income levels.

Engel Curves

The first attempt to analyze cross-sectional data based on a theoretical model was the work by Allen and Bowley (1935). They estimated linear equations which automatically satisfy the adding-up restriction but were very restrictive form of the underlying utility function that was implied. In addition, the implications of linearity in terms of the income elasticities were unsatisfactory from an economic point of view (luxury goods resulted with negative dE_i/dy), and the statistical fit was very poor (Phlips, 1974, p. 109).

Pollak (1971) thoroughly analyzed the implications of linear Engel curves. He defined a demand system by

$$\{h^1(p,u), \ldots, h^n(p,u)\}$$

where p represents the price vector $(p_1, \ldots, p_n)$ and

$$u = \sum_{i=1}^{n} E_i = y$$

He characterized the demand functions in the following way: if the demand functions are of the form

$$h^i(p,u) = x_i(p) + z_i(p)u$$

in some region of the price-income space, the demand functions are locally linear in income, if

$$h^i(p,u) = z_i(p)u$$

the demand functions exhibit expenditure proportionality, this is a especial type of linearity.

The demand functions are linear in income if and only if the marginal budget shares of the ith good

$$m_i\ (p, u) = (\partial p_i h_i(p, u)) / \partial u$$

are functions of prices alone, independent of income. The income-consumption curves are straight lines in a region of the commodity space if and only if the demand functions are linear; they are straight lines radiating from the origin if and only if the demand functions exhibit expenditure proportionality.

Pollak proved a theorem stating that additive utility functions yield demand functions which are locally linear in income if and only if they are of the form

$$U = \sum_{k=1}^{n} a_k \log(\, q_k - b_k\,),\ a_i > 0,\ (q_i - b_i\,) > 0,\ \Sigma\, a_k = 1\ ,$$

$$U = \sum_{k=1}^{n} a_k\,(\, B_k + \delta_k\, q_k\,)^{c},$$

or

$$U = -\sum_{k=1}^{n} a_k e^{-B_k q_k}\ ,\ a_k\ ,\ B_k > 0.$$

He pointed out that in demand analysis the assumption that all income elasticities are unity has little merit and that the additivity assumption is defensible if the arguments of the utility function are taken to be broad aggregates of goods rather than individual commodities.

Prais and Houthakker (1955) analyzed non-linear functions to estimate Engel curves were adapted to income consumption patterns. In fitting income-consumption equations they took into account a priori economic as well as statistical considerations. They incorporated two properties in the algebraic formulations: a) that there is an initial income below which a commodity is not purchased, and b) that there is a satiety level, that is, a maximum to the quantity of the commodity consumed which is not exceeded however high income may rise. Based on these considerations they chose the following models:

$\log E_i = a_i + b_i \log y$, double-logarithmic,

$\log E_i = a_i - (b_i / y)$, log reciprocal

$E_i = a_i + b_i \log y$, semi-logarithmic

$E_i = a_i - (b_i / y)$, hyperbolic.

Prais and Houthakker concluded that none of the functions were uniformly satisfactory. The double-logarithmic form gave fairly satisfactory results for most commodities except for the difficulty of treating zero expenditures. The semi-logarithmic form gave a satisfactory description of expenditures on most foodstuffs, and all non-linear forms proved to give better estimates than those given by the linear form

With respect to the work of Prais and Houthakker, Phlips pointed out that, while much has been gained with this pragmatic approach in terms of descriptive power, much has been lost in terms of theoretical plausibility. Non-linear specifications are not compatible with utility maximization, as they do not satisfy the adding-up criterion. He makes the same criticism of the work of Aitchison and Brown (1957), Wold and Jureen (1953) and Champernowne (1969).

Leser (1963) investigated the properties of various forms of Engel functions satisfying the additivity criterion using nine commodity groups. He took into consideration several factors in choosing among various functional forms. These factors included the close connection with a direct or indirect utility function, the validity of the function for all positive values of total outlay within a wide range, and the plausibility of the income elasticities besides the statistical goodness of fit. He concluded that the equations used by Working (1943) of the form

$$w_i = a_i + b_i \log y + e_i$$

where $w_i = E_i/y$ describe a behavior which would seem acceptable, and that the goodness of fit criterion tends to reinforce the theoretical considerations in favor of this model.

The above model was rejected by Prais (1953). In that work he comments that Stuvel and James in their study of households expenditure on food in Holland showed that neither the linear nor the exponential forms were appropriate for the whole range of budgets in that collection. In his conclusion, Prais suggests that a typical Engel curve may be described by the equation

$$(E_i/N) = a + b \log (y/N)$$

where N is household size in equivalent adults. The above equation means that the income elasticity is inversely proportional to the expenditure on the commodity. To specify the behavior of the Engel curve for quantities he takes into account the change in quality measured by the average price per physical unit of the commodity and describes it by the equation

$$p = h + k \log (y/N)$$

where p is average price paid per unit of commodity. Dividing expenditure by price he obtained the quantity consumed

$$\frac{q}{N} = \frac{a + b \log (y/N)}{h + k \log (y/N)}$$

i.e.

$$\frac{q}{n} = A \frac{B + \log (y/N)}{C + \log (y/N)}$$

where A, B, and C are constants respectively equal to b/k, a/b, and h/k (Prais, 1953, p. 101-102).

Prais pointed out that this equation for the Engel curve for quantities seems very satisfactory, giving an asymptote equal to A, and consumption falling to zero at a positive income.

An Alternative Method of Estimating Engel Curves

A new method of estimating Engel elasticities was proposed by Kakwani (1978). The new equation of the Engel function was based on a coordinate system for the Lorenz curve developed by Kakwani and Podder (1976). The equation of the Lorenz curve was fitted to the expenditure data and then the expenditure elasticities were derived in terms of the estimated parameters of the Lorenz curve for total expenditure and expenditure on each commodity.

The income elasticities derived from the Engel functions investigated above were either constant or monotonically increasing or decreasing. The actual data indicated that the elasticities may not be either constant or monotonic (Kakwani, 1978, p. 103).

To estimate the Lorenz curve, Kakwani and Podder (1976) defined x as per capita total expenditure or income of a family; x is a random variable with mean M and the probability distribution function $F(x)$. If $F(x)$ is the proportion of families having income less than or equal to x, then

$$F_1(x) = (1/M) \int_0^x x\ g(x)\ dx$$

is the first moment distribution function, where $g(x)$ is the density function of x The Lorenz curve is the relationship between $F(x)$ and $F\ (x)$ This relationship is shown in Figure 2.1. Let P be any point on the curve with coordinates F and F Then, by introducing a new coordinate system (see Appendix 3),

$$\pi = (F + F_1)/\sqrt{2} \qquad \text{and} \qquad \eta = (F - F_1)/\sqrt{2}\ ,$$

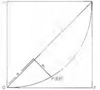


Figure 2.1. Kakwani and Podder coordinates for [illegible] a Lorenz curve

[illegible]

$$[illegible]$$

and

$$[illegible]$$

The model fitted was

$\eta = a x^{d}(\sqrt{2} - \eta)^{\beta}$, a > [illegible]

Kakwani (1978, p. 104) denoted v_i [illegible] Engel function of the ith commodity which has [illegible] per capita expenditure M_i, then the function

$$F_i[v_i(x)] = (1/M_i)\int_0^x v_i(x)\,g(x)\,dx$$

is interpreted as the proportion of per capita expenditure on the ith commodity of the families having a total per capita expenditure less than or equal to x. The concentration curve of the ith commodity is given by the relationship F(x) and $F_i[v_i(x)]$ (Kakwani 1978, p. 104; 1977, p. 720). In terms of η_i and π_i the result is

$$\pi_i = (1/2)[F(x) + F_i(v_i(x))]$$

$$\eta_i = (1/2)[F(x) - F_i(v_i(x))]$$

The concentration curve can be written as [illegible], and the derivatives of η_i with respect to π_i are

$$f_i'(\pi_i) = \frac{M_i - v_i(x)}{M_i + v_i(x)} \qquad (3)\ ,$$

$$f_i''(\pi_i) = \frac{2\sqrt{2}\, M_i^2\, v_i'(x)}{-g(x)[M_i + v_i(x)]^3} \qquad (4)\ .$$

Combining (1), (2), (3), and (4) the Engel elasticity of the ith commodity is obtained as

$$\frac{\partial v_i(x)}{\partial x}\,\frac{x}{v_i(x)} = \frac{v_i'(x)x}{v_i(x)} = \frac{f_i''(\pi_i)[1 + f'(\pi)]^2\,[1 - f'(\pi)]}{f''(\pi)[1 + f_i'(\pi_i)]^2\,[1 - f_i'(\pi_i)]} \quad (5)$$

Kakwani (1978, p. 105) pointed out that if the data on different commodities are available in grouped form arranged according to total per capita expenditure or income, this equation can be used to compute expenditure elasticities at the end point of each expenditure class. To compute elasticities at any income level the following relationship can be used.

$$\pi + f(\pi) = \pi_i + f_i(\pi_i)\ .$$

The function fitted was the same assumed by Kakwani and Podder (1976)

$$y_i = a_i - {}_1 \, (\sqrt{Y_i} - {}_1)^2_1$$

[illegible] was estimated using ordinary least squares method.

Blaylock and Smallwood (1982) applied the method discussed above to estimate expenditure elasticities among three urbanizations for several food groups. They introduced a generalized functional form to describe the Lorenz and concentration curves. The model developed was

$$\eta^{(\lambda)} = A^* + \alpha x^{(\nu)} + B^*(\sqrt{Z} - \gamma)^{(\delta)} + u$$

where λ, ν, δ, A^* and B^* are parameters and u is the error term. This equation approaches the function used by Kakwani and Podder as all transformation parameters approach zero. The equation was estimated using maximum likelihood technique since it is nonlinear in the parameters. Blaylock and Smallwood concluded that, as income increases, elasticity patterns can be nonmonotonic and the pattern found in their analysis could not be obtained using traditional methods of analysis. This added flexibility for estimating Engel parameters is important for policy analysis involving the impact of income transfer programs on population subgroups located at extremes of the income distribution (Blaylock and Smallwood, 1982, p. 139).

Application of the Frisch Method

In an effort to compute all direct and cross price elasticities, Frisch (1959) made the assumption of want independence and suggested a method of obtaining the price elasticities with knowledge of the budget shares, the income elasticities, and the flexibility of the marginal utility of money. In his work, he defined marginal utilities as a function of the quantities

$$u_i = u_i(q_1, \ldots, q_n) \quad , \; i = 1, 2, \ldots, n$$

and the inverse function as

$$q_i = q_i(u_1, \ldots, u_n) \quad , \; i = 1, 2, \ldots, n,$$

he also defined

$$u_{ik} = \frac{\partial u_i(q_1, \ldots, q_n)}{\partial q_k} \; \frac{q_k}{u_i(q_1, \ldots, q_n)} \quad \begin{matrix} , \; i=1, 2, \ldots, n \\ , \; i=1, 2, \ldots, n \end{matrix}$$

as the utility acceleration which is the elasticity of the marginal utility with respect to q_k . And he defined

$$q_{ik} = \frac{\partial q_i(u_1, \ldots, u_n)}{\partial u_k} \; \frac{u_k}{q_i(u_1, \ldots, u_n)} = \epsilon_{ik}$$

as the want elasticity. This elasticity tells the proportionate change in the want for a good with respect to the change in quantity of other goods. Frisch defined good i is want independent of all other goods if $q_{ik} = 0$ for all $k \neq i$, or equivalently $q_{ki} = 0$ for all $k \neq i$. Another equivalent definition he gave was that good i is want independent of all other goods if $u_{ik} = 0$ or $u_{ki} = 0$ for all $k \neq i$, $u_{ik} = 0$ means that the marginal utility of good i depends only on the quantity of good i and not on any other quantity. These concepts can be applied to broad aggregates, want independence will not hold with single commodities.

The marginal utility of money is $\partial U/\partial y$. From the first order conditions of constrained utility maximization

$$\lambda = (u_i)/(p_i)$$

and the elasticity of the marginal utility of money with respect to income is

$$(\partial \lambda / \partial y)(y/\lambda) = \phi$$

and is called the flexibility of the marginal utility of money or money flexibility.

Using these results Frish developed the relationship for the price elasticity as

$$e_{ij} = \sigma_{ij} - w_j e_{iy} - (1/\phi) w_j e_{jy} e_{iy}$$

where e_{ij} is the cross price elasticity of good i with respect to the price of good j; w_j is the budget share of good j, e_{iy} is the income elasticity of good i, and ϕ and σ_{ij}

are as defined above. This relationship is analogous to the classical Slutsky relation

$$e_{ij} = e_{ji}(w_j/w_i) + w_j e_{jy} - e_{iy}$$

and

$$e_{iy} = -\sum_j e_{ij} \quad (i,j = 1,2, \ldots, n)$$

which can be compared with the classical relation that states the restriction that

$$\sum_j e_{ij} = -e_{iy} \text{ , (homogeneity restriction) .}$$

Now if a good i is want independent of all other goods, $\sigma_{ij} =$ 0 for all i ≠ j and the cross price and income elasticities can be simplified to the relation

$$e_{ij} = - w_j e_{iy} - (1/\phi) w_j e_{jy} e_{iy}$$

$$e_{ij} = - e_{iy} w_j [1 + (e_{jy}/\phi)] \text{ , (cross price elasticity)}$$

$$e_{iy} = \phi \sigma_{ii} \text{ , (income elasticity)}$$

so

$$\sigma_{ii} = (e_{iy}/\phi)$$

thus

$$e_{ii} = \sigma_{ii} - w_i e_{iy} - (1/\phi) w_i e_{iy} e_{iy}$$

$$e_{ii} = (e_{iy}/\phi) - w_i e_{iy} - (1/\phi) w_i e_{iy} e_{iy}$$

$$e_{ii} = - w_i e_{iy} + e_{iy}[(1-w_i e_{iy})/\phi]$$

$$e_{ii} = - e_{iy}[w_i - (1-w_i e_{iy})/\phi)]$$

from which ϕ can be obtained, i. e.

$$\phi e_{ii} + \phi e_{iy} w_i = e_{iy} - w_i e_{iy} e_{iy}$$

[illegible] $e_{ij} - w_j e_{iy} e_{jy}$

$$[illegible] \frac{e_{ij} - w_j e_{iy} e_{jy}}{w_j + e_{iy} w_j}$$

([illegible] King, 1971, p. 22-2[illegible])

The disadvantages of using this approach are that want independence imposes complete additivity in the utility function (which implies that the marginal utilities of i and j are unaffected), and that the e_{ij} are not invariant for any monotonic transformation of the utility function.

Frisch pointed out that his development can be extended to the case where there are groups of commodities in which there may be dependence within each group, but want independence between a good in a given group and all the goods in the other groups. In this case, in addition to the budget share, w_i, the income elasticity, e_{iy}, and the money flexibility, ϕ, the cross price elasticities for the commodities within the groups are needed.

George and King (1971) made a full application of this method, estimating a demand system for food commodities in the United States. They used most of the theoretical restrictions on demand systems and made full application of the Frish relations developed above.

In order to apply the Frish method, they imposed the assumption of want independence for all commodities outside a given group to obtain all the cross price elasticities of commodities between different groups. The direct and cross price elasticities of commodities within each group were estimated directly using time-series data.

They estimated a demand system for 49 commodities grouped in 15 separable groups. The demand equations were specified with quantities as dependent variables. The independent variables included income, the price of all commodities belonging to the same group, and the price indices of other groups.

To obtain the income elasticities from cross-sectional data, they used both ordinary and weighted regressions. The regression equation obtained was

$$\log q = a + b \log y$$

where q is per capita quantity consumed and y is per capita income. They also evaluated the effect of household size on consumption in the cross-sectional analysis. Expenditure and quantity were used as dependent variables. The regression equations were of the form

$$\log q = a + b \log y + c \log N$$

and

$$\log E = a' + b' \log y + c' \log N$$

where E represents expenditures, and N household size. The quality elasticity was also analyzed, with and without household size. This measure was obtained from the [illegible] of the [illegible] and quality [illegible] calculated [illegible] of the [illegible] calculated [illegible] remaining [illegible].

Price Elasticities From Cross-Sectional Data

Several attempts have been made to estimate price elasticities from household budgetary data. The approaches to this problem can be classified as three kinds. First, estimates of direct and cross price elasticities have been obtained making strong assumptions about the underlying utility function. The second approach has been based on pooling cross-sectional and time series data to overcome the restriction on the number of observations that usually exists when using only time series. The third kind is aimed at capturing the price variations during the time period covered by the household budget surveys, which in most cases requires enough time to observe some price variation.

Friedman (1935) discussed a method suggested by Pigou, as early as 1910, of using budgetary data to obtain the ratio of the elasticity of demand for one commodity to that for another. Pigou's method is based upon the assumptions that the marginal utility of a commodity to an individual is a function solely of the quantity of that commodity possessed, [illegible] the marginal utility curve for a commodity is the same for each individual. He then makes the utility elasticity equal to the price elasticity. Friedman shows that that assumption would hold only if there is a very large number of commodities purchased or if at least one commodity has a very large utility elasticity.

Leser (1941-42) reviewed the assumptions that have to be made in order to estimate price elasticities from budget data. He pointed out that the assumption made by Marshack —that the difference between the income and price elasticities of demand for a commodity is negligible if the amount spent on it is small compared with total expenditure —was rejected by Frisch who showed that the observed income elasticities can not be interpreted as price elasticities. In his work to obtain price elasticities, Leser assumed that the cross elasticities of demand depended on the nature of the good whose price changes, and not on the nature of the good for which the effect was studied. This assumption excluded a high degree of substitution or complementarity, and thus would be valid only for broad aggregates and not for single commodities.

Hassan and Johnson (1976) estimated consumption functions and Engel curves based on cross-sectional data from a family budget in Canada. They also examined hypotheses of possible structural change related to six socioeconomic characteristics. These included size of urban community in which the family resided, class of tenure, age of family head, family life cycle, family income, and education of family head. In this study the Engel curve was approximated with a linear function. To justify this functional form they pointed out that the aggregate level of the commodity groups should not involve a substantive misspecification error, that is, the commodities as they were grouped were neither luxuries nor inferior goods.

In a new study using cross-sectional data from an urban family food expenditure survey in Canada, Hassan and Johnson (1977) estimated demand parameters for 122 food items and computed, from these estimates, elasticities for expenditure, income, quality, family size, and price. The price elasticities were computed by using implicit prices derived from the expenditure and quantity data. This time they fitted a semi-logarithmic function to approximate the Engel functions, which implied that elasticities vary inversely with the level of consumption. Among the reasons they gave for choosing this functional form were that the semi-logarithmic function gives a satisfactory description of expenditures for most food commodities, that this form allowed observations of zero for the dependent variable (which occurs frequently when microdata are used), and that even though this function does not satisfy the adding-up criterion, it provides an appropriate representation of Engel curves for the range in which the income elasticity is less than one.

To estimate the price elasticities, Hassan and Johnson (1977) used the price variations within the period over which the survey data were collected. In the survey which provided the source of their data the period was one year. They pointed out that during such a period, price variations are likely to be small and statistical measurement cannot be overly ambitious. So the estimated models must include a large amount of prior information. They included only own price elasticities in the demand functions.

They concluded that the price variations that occurred within the sample period were sufficient for estimating the coefficient necessary to compute the elasticities, and that the estimated parameters were consistent with theory and with available elasticity estimates from time series data.

Demand Estimates in the Dominican Republic

A few attempts have been made in the Dominican Republic to estimate income and price elasticities. All of them faced the problem of inadequate data, time series data did not exist at all for some crops or food commodities and when they existed they were very inconsistent (USDA, 1977, p. 103). Cross-sectional data first became available in

1971, from a household income and expenditure survey (Banco Central, 1971), but only for the city of Santo Domingo. Later, in 1976-77 the Central Bank conducted a new household income and expenditure survey (this time at a national level), whose final results were available in May 1982.

Erichson, House, and Nunez estimated income and price elasticities for several crops (USDA, 1971). In their work, they rejected the use of time series because of the lack of meaningful data which led to very poor results. They used the Frish method (discussed earlier) to estimate price elasticities. Estimates of expenditure elasticities and budget shares were derived from the 1969 household income and expenditure survey. The money flexibility coefficient was taken from cross-country studies done by de Janvry, Bieri and Nunez (1972), Lluch and Williams (1975), and Le-Si and Pomareda (1976). In this way they calculated direct price elasticities for nine crops.

Another study using data from the 1969 household survey was done by ONAPLAN to estimate gross income elasticities between two income groups (see discussion on pages 2 and 3).

In a preliminary study using data from the 1976-77 household survey, Del Rosario and Musgrove (1980) estimated consumption functions for 13 groups comprised of 67 single commodities. They worked with data grouped by 10 income classes. The expenditure on each commodity, E_i, and the quantity of each commodity, q_i, were regressed separately against total expenditure, y. The models fitted were as follows:

$$\log q_i = a_i + b_i/y + c_i \log y \quad , \text{ and}$$

$$\log E_i = a_i' + b_i/y + c_i \log y$$

where $a_i' = a_i + \log p_i$.

The authors suggested extension of their work by including more explanatory variables such as family size and geography location. They also suggested that this kind of estimation be done with single household data (Del Rosario and Musgrove, 1980, p. 28).

Quezeda (1981, p. 162, 219) estimated demand equations for 6 commodities using data from a 14-years time series on prices and expenditure. He fitted a linear model deflating all prices and consumption expenditures by the consumer price index. In the model he included per capita consumption of the product as a function of its own price and of prices of some substitutes or complements, and per capita consumption expenditures.

The Limited Dependent Variable Model

When working with cross-sectional data from a household survey many of the observations on the consumption of specific goods will be zero, since at the time of the survey the consumer did not buy that good, so the consumption variable is not observed over its entire range (Tobin, 1958 p. 24). As described by Maddala (1977, p. 162), if

$$q = bx + e$$

and q is observed only if it is greater than zero, then

$$q = bx + e \quad \text{if } bx + e > 0 \quad \text{or } e > -bx \quad \text{or}$$
$$q = 0, \text{ i.e., } \quad e \leq -bx \quad \text{otherwise.}$$

Ordinary least squares cannot be used to estimate the regression equations using only the observations for which q> 0 because the residuals do not satisfy the assumption that E(e) = 0, if only those residuals for which e > -bx were used. Making some specific assumption about the distribution of the error term, e, the maximum likelihood method can be used to estimate the parameters. If, for instance, it was assumed that e has a normal distribution, with mean zero and variance σ^2, the joint distribution of the observations is

$$L = \prod_1 \frac{1}{\sigma} f((q_i - bx_i)/\sigma) \prod_2 F(-bx_j/\sigma)$$

where $f((q_i - bx_i)/\sigma)$ is the standard normal density, and represents the observations for which q_i was observed, and [illegible] is the cummulative normal density, and represents the observations at the limit, i.e. where $e = -bx$ when the [illegible]. The ML estimates are obtained by maximizing L with respect to b and σ (Maddala, 1977, p. 136). Tobin (1958) pointed out that if only the probability of limit and nonlimit responses were to be estimated, the probit analysis would be appropriate, but that it would be inefficient to throw away information on the value of the dependent variable when it is available. So he developed what he called a hybrid of probit analysis and multiple regression, that was later to be known as the tobit model

CHAPTER III

METHODOLOGY

The Restrictions of Consumer Theory

In this study, a demand system for food commodities was estimated using the general restrictions of consumer theory. The restrictions also serve to reduce the number of parameters to be estimated. Some price elasticities were estimated directly. In such cases the variation in prices over the period in which the data were collected was used.

The general restrictions on demand coefficients comprise the following:

$$\sum_j e_{ij} = -e_{iy} \quad \text{(Homogenity Condition)}$$

$$i, j = 1, \ldots, n$$

$$\sum_i w_i e_{iy} = 1 \quad \text{(Engel Aggregation)}$$

$$i = 1, \ldots, n$$

$$e_{ij} = (w_j/w_i)e_{ji} - w_j(e_{iy} - e_{jy}) \quad \text{(Symmetry Relation)}$$

$$i, j = 1, \ldots, n$$

$$\sum_i w_i e_{ij} = -w_j \quad \text{(Cournot Aggregation)}$$

where e_{ij} represents the elasticity of good i with respect to the price of good j, e_{iy} represents the income elasticity of good i, $w_i = p_i q_i / \Sigma p_i q_i$ is the budget share of good i, and n is the number of goods.

The Demand Models

A semi-logarithmic model was hypothesized for the demand functions. The equations were of the form

$$q_i = a'_{i0} + a_{i1} \log p_1 + \ldots + a_{in} \log p_n + b_i \log y + c_i \log m + u_i$$

where q_i represents quantity consumed by the household of good i, for i=1,...,n, p_j represents prices of good j, for j=n-k and k=0,...,n-1, n is the number of commodities (some are single commodities and some represent groups of commodities), y represents the household total expenditure (which is also referred to as income in this study), m is the number of members in the family, adjusted for adult equivalents; u_i is the error term, and $a'_{i0} = \log a_{i0}$.

There exists an extensive literature on the measurement of household size. Brown and Deaton (1972, p. 1178-1186) reviewed many of the proposed scales to adjust the size of the family for adult equivalent, they pointed out that such scales, including the nutritional scales, are based on normative judgments rather than on market behavior. Nevertheless, for this study it was considered that from a practical point of view it would be better to make some adjustment in the number of members, since all of them do not consume the same quantities of the different food commodities. The scale used was to consider any family member 14 years old or less as 0.5 of an adult equivalent.

Using the proposed semilog models, the estimation procedure was as follows the first equation had n prices as independent variables plus total expenditure and number of adult equivalent household members, the second equation had n-1 prices as independent variables plus total expenditure and number of adult equivalent household members, and so on up to the 30th equation which had only its own price along with total expenditure and number of members. The estimation procedure is shown in Table 3.1.

A few exceptions were made to include the prices of some products that were known, a priori, to have an important effect on the respective demand equations, and that would not be included if the procedure had been followed. These exceptions were made for cassava, where the price of plantain was included, for other-meats, where the prices of beef and pork were included, for other-roots, where the price of cassava was included, for other-milk, where the price of fresh-milk was included, and for banana,

Table 3.1. Estimation procedure [illegible]

$$
\begin{aligned}
q_1 &= a'_{1,0} + a_{1,1}\log p_1 + a_{1,2}\log p_2 + \ldots + a_{1,29}\log p_{29} + a_{1,30}\log p_{30} + b_1\log y + c_1\log m + u_1\\
q_2 &= a'_{2,0} \qquad\qquad + a_{2,2}\log p_2 + \ldots + a_{2,29}\log p_{29} + a_{2,30}\log p_{30} + b_2\log y + c_2\log m + u\\
&\quad\vdots \qquad\qquad\qquad\qquad \vdots\\
q_{29} &= a'_{29,0} \qquad\qquad\qquad\qquad + a_{29,29}\log p_{29} + a_{29,30}\log p_{30} + b_{29}\log y + c_{29}\log m + u_{29}\\
q_{30} &= a'_{30,0} \qquad\qquad\qquad\qquad\qquad\qquad + a_{30,30}\log p_{30} + b_{30}\log y + c_{30}\log m + u_{30}
\end{aligned}
$$

$a'_{ij} = \log a_{ij}$

[illegible] fruits was included. However, the coefficients of these prices were not considered in the calculations of the price elasticities, they were included just to lessen specification errors for the estimated parameters used in the calculations. (See estimated coefficients of regressions in Apendix 2.)

Use of the Tobit Model

To estimate the demand equations the tobit model was applied to the semilog forms for each single equation. The usefulness of this estimation method is twofold, it provides a way to use all observations including those which are concentrated at the zero limit value, it also allows the use of all the observations in the estimation of each equation; this was important, since otherwise each equation would have had a different number of observations and it would not have been possible to establish the relationships between the elasticities of different goods consistently with the same data set for each equation.

To overcome the remaining problem of missing values in the prices of some goods in each equation, the average prices of the respective goods were used in place of the missing values (Maddala, 1977, p. 202).

Since the purpose of the estimation of these equations was to establish a functional form for the demand functions and to obtain the respective regression coefficients, the observations were not weighted. A similar procedure was followed by Tobin (1958, p. 31) who stated that it may well be that the sample gives unbiased estimates of the parameters of the relationship, even though it gives biased estimates of the separate frequency distributions of the variables.

The estimations of the mean quantities consumed and of the mean prices, as well as that of the budget shares, were made using weighted observations.

The Elasticities Matrix

The elasticities matrix was comprised of direct and cross price elasticities plus income elasticities for 30 food groups, the all food aggregate, and one nonfood group. The 30 food groups and the variable names used for each of them are listed in Figure 3.1.

Since the estimated values of the elasticities would not be invariant to the ordering of the commodity groups within the matrix, the groups were arrayed in descendent order according to the budget shares. In this way the group, or commodity with the largest share of the consumer expenditure would be in the first row. As can be seen in Table 3.1, the item in the first row is the one with more coefficients estimated directly. The number of coefficients

RIC - Rice
FAT - Fat and oils
BEF - Beef
FMK - Fresh milk
PTN - Plantain
RBN - Red beans
BEV - Non-alcoholic beverages
POL - Poultry
FDW - Food away from home
FVG - Fresh vegetables and soups
SPC - Spices and miscelaneous
POR - Pork
SUG - Sugar
OCE - Other cereals
FIS - Fish
BRE - Bread
CAS - Cassava
OFT - Other fruits
OMT - Other meats
EGG - Eggs
ALC - Alcoholic beverages
ORT - Other roots
OMK - Oter milk and milk products
BAN - Banana
CHE - Cheese
OLG - Other dried legumes
CVG - Canned vegetables and soups
POT - Potato
NUT - Nuts
OBK - Other bakery products
ALL - All food commodities
NON - Non-food commodities

Figure 3.1. Definition of consumption groups

assumed was increased by one for each additional [illegible] the matrix. The strategy was to attempt to minimize specification errors for the most important items in the budget.

The elasticities were calculated using the coefficients estimated with the tobit model:

Own price and cross price elasticities, e_{ij}, with respect to those prices which were included in the estimation equations (see Table 3.1) were calculated directly. The estimated regression coefficients were divided by the weighted mean of the dependent variable (the quantity consumed of each commodity or group) to obtain the estimated elasticities. To see the reason for using this procedure consider the semi-logarithmic model,

$$q_i = a'_{im} + \sum_{j=1}^{k} a_{ij} \log p_j + b_i \log y + c_i \log m$$

where k = the number of prices included as independent variables in the ith equation. Here,

$$\partial q_i / \partial p_j = a_{ij}/p_j \quad \text{and}$$

$$e_{ij} = (\partial q_i/\partial p_j) \cdot (p_j/q_i) = (a_{ij}/p_j) \cdot (p_j/q_i) = a_{ij}/q_i$$

the income elasticity e_{iy} and the elasticity with respect to the number of members, e_{in}, were calculated following the same procedure, so

$$e_{iy} = b_i / q_i \quad \text{and} \quad e_{im} = c_i / q_i$$

Nelson (1976) has derived elasticity estimates for the tobit model based on the expected quantities consumed given values of the independent variables (in this study price, income, and family size). His derivation leads to the formula

$$e_i = [B_i P_i F(B'P/\sigma)] / [B'PF(B'P/\sigma) + \sigma f(B'P/\sigma)]$$

For the semi-logarithmic model specification used in this study the P_i would cancel and the formula would reduce to

$$e_i = [B_i F(B'P/\sigma)] / [B'PF(B'P/\sigma) + \sigma f(B'P/\sigma)]$$

$$= \frac{B_i}{B'P + [\sigma f(B'P/\sigma)/F(B'P/\sigma)]} .$$

This value for the elasticity is approximately equal to (a_{ij}/q_i) for values of $(B'P/\sigma)$ over 2.5. There is some overestimation of the elasticities at the mean quantities versus expected quantities for purposes of national policy. However, the overestimation with the method used was minor.[1/]

The rest of the elasticities for the food [illegible] and groups were calculated using the symmetry restriction. For example, the element in the second row and first column, e_{21}, of the elasticity matrix in Table 4.2, was estimated as

$$e_{2,1} = (w_1/w_2)e_{1,2} - w_1(e_{2,y} - e_{1,y}).$$

The rest of the elasticities in that row were obtained using the estimated coefficients as explained above.

The elasticities of each food group with respect to the prices of the all-food aggregate, e_{if}, were obtained as the sum of all the price elasticities in the ith row, or $e_{if} = \sum_j e_{ij}$.

The elasticity of the all-food aggregate with respect to the prices of each food group, e_{fj}, was calculated using the symmetry relation, from the price elasticities of the food groups with respect to all-food, e_{if}.

The own price elasticity of the all-food aggregate, e_{ff}, was obtained as the sum of all the price elasticities of the all-food aggregate with respect to the price of each food group, e_{fj}, or $e_{ff} = \sum_j e_{fj}$.

The price elasticities of each food group with respect to the price of the non-food group, $e_{i,nf}$, were calculated using the homogeneity restriction

$\sum_j e_{ij} + e_{i,nf} + e_{iy} = 0$ but

$\sum_j e_{ij} = e_{if}$ then

$e_{i,nf} = - e_{iy} - e_{if}$

The elasticities of the nonfood group with respect to the price of each food group, $e_{nf,j}$, were calculated using the symmetry relation and the price elasticities of each food group with respect to the nonfood group, $e_{i,nf}$.

The income elasticity of the all-food aggregate, e_{fy}, was obtained as the weighted sum of the income elasticities of each food group, using the budget shares as weights, or

$$e_{fy} = \sum_i w_i e_{iy} / \sum w_i = \sum_i w_i e_{iy} / w_f$$

The income elasticity of the nonfood group was obtained using the Engel aggregation, or

$$\sum_i w_i e_{iy} + w_{nf} e_{nf,y} = 1 , \text{ i.e}$$

$$e_{nf,y} = (1 - \sum_i w_i e_{iy})/w_{nf} ,$$

The cross price elasticity of the nonfood group with respect to the price of the all-food aggregate was calculated using the homogeneity restriction or [illegible] but

[illegible] then

[illegible]

The cross price elasticity showing the effect of the all-food aggregate on the nonfood group, $e_{nf,f}$, was calculated from the symmetry relation based on $e_{f,nf}$.

The own price elasticity for the nonfood group, $e_{nf,nf}$, was obtained from the homogeneity condition as

$$e_{nf,nf} = - \Sigma e_{nf,j} - e_{nf,y} .$$

The Effect of Price and Income Changes on Calorie and Protein Intake

The elasticity matrix was used to estimate the effect of changes in prices on the intake of calories and protein. The procedure, in general, was as follows: the contents of calories and protein in one pound of each commodity, c_i and p_i, respectively, were estimated from tables on food composition from INCAP-ICNND (1961), OHAPLAN (1980b), and Whitney and Hamilton (1977), and the percentage change in the average consumption of each food commodity, or food group, per capita, per day, $\bar{q}_i$, when the price p_j changed 1 percent was estimated from the price elasticities, e_{ij}. The equation for estimating the change in consumption was

$$\Delta\bar{q}_{ij} = (e_{ij}/100)\bar{q}_i \; .$$

Thus, the estimated change in calories consumed from the good i when p_j changed 1 percent was

$$\Delta c_{ij} = \Delta q_{ij} \cdot c_i \; ,$$

and the estimated total change in calories consumed from all food commodities, when p_j changed 1 percent was

$$\Delta C_{ij} = \sum_i \Delta c_{ij} = \Delta c_{1j} + \Delta c_{2j} + \cdots + \Delta c_{30,j} \; ,$$

where i, j = 1,...,30.

The change in protein intake as a result of a change in price and changes in calories and protein intake as a result of a change in incomes were determined in an analogous way. In the policy analysis some assumptions on price and income changes will be evaluated and compared with the goals of nutrition in regard with income changes and food imports

The Data

Data from the "First National Survey of Household Income and Expenditure" ([illegible]) collected by the Central Bank of the Dominican Republic and the National Office of Statistics, were used. The first objective of the survey was to obtain the information necessary to calculate the official cost of living index. The data were collected during the period from May 1, 1976, to April 30, 1977. They were based on a probabilistic sample by areas in multiple stages. The probability of one household being selected in the sample was 0.005 or one in each 200 households. The final sample used in this study was comprised of 4,027 households. The urban and rural distribution and a comparison with the 1970 census are shown in Table 3.2.

In the data there were 477 consumption items, of which 222 were food. The 477 items were grouped into 30 food groups (some groups were single commodities) and one nonfood group. The 30 food groups are shown in Figure 3.1. (Consumption items in the food groups are given in Appendix 1.) In the equations estimated (Appendix 2) the logarithms of the prices used as independent variables were designated with the three letters given in Figure 3.1 preceded by the letter L. For example, the logarithm of the price of fats and oils is designated LFAT in Appendix 2.

Table 3.2. Sample size and urban and rural distribution of the "First National Survey on Household Income and Expenditure" in the Dominican Republic with comparisons to the 1970 census

	Sample No. of Households	Percent	1970 Census No. of Household	Percent
Total	4,027	100.0	779,920	100.0
Urban Area	1,681	41.7	309,447	39.7
Rural Area	2,346	58.3	470,473	60.3

Note

1. For example, [illegible] the elasticities for rice at the expected quantities consumed led to the following estimates: -.46, .01, -.12, -.22, -.0[illegible], [illegible], [illegible], -.00, -.07, [illegible] -.05, -.25, -.22, .05, -.00, [illegible], [illegible], -.07, -.07, [illegible] .02, -.06, .02, -.01, .03, -.00, .02, .15, -.04, -.00, [illegible] .56. When respectively compared to the first row of Table 4.2 it can be seen that the overestimation was slight.

CHAPTER I[illegible]

EMPIRICAL RESULTS

Tobit Model Estimates

The tobit model was used to estimate the demand equations following the procedure described in the methodological section. These coefficients and the t values associated with their implicit standard errors are shown in Appendix 2.

The coefficient for the own price in each demand equation, except in the demand for canned-vegetables-and-soups (CVG), had the expected negative sign. This sign implies an inverse relationship between the price of a good and the quantity demanded of it.

Also the absolute value of the coefficient of the own price in each demand equation, with the exception of CVG, was greater than the coefficients of all other prices. This result shows that, as expected, the effect of the own price is more important than the effect of other prices on the demand for a good.

The coefficient of total expenditures for all the commodities had a positive sign implying that there were no inferior goods among the food groups.

The t statistics reported in Append[illegible] indicate that the elasticities of demand with respect to own price and the elasticities of demand with respect to income were estimated most accurately relative to their standard errors. With cross-sectional survey data the variation in income is greater than in prices and it would be expected a greater accuracy in measuring income effects. The high t ratios for own price effects suggest that there was enough price variation to consistently measure price effects. The t ratios for the number of household members was also in general indicative of an effect of household size on the purchases of food items.

The coefficients showing the effect of the size of the family on the quantities consumed of food commodities, in general, had positive signs. The exceptions were a few commodities (BEF, FDW, OMT, ALC, OFT, OMK, CHE, and OEE) which might be considered luxury goods within the food groups due to their high prices (see Table 4.1). This conclusion is reinforced by the estimated income elasticities for those commodities, which were all greater than one. The point is that when the family size increases with a given income, cheaper foods are substituted for more expensive foods.

All the coefficients from the regression in one demand equation were divided by the mean quantities consumed of the

Table 4.1. Average expenditure proportions, quantities consumed, and weighted average prices paid by households in the "First National Survey on Household Income and Expenditure", by food group

Food Group	Expenditure Proportions	Average Quantity Consumed	Weighted Average
		pounds/month	$/pounds
RIC	0.0728	63.9910	0.25
FAT	0.0490	12.0711	0.97
BEF	0.0303	8.3404	0.78
FMK	0.0257	4.5411	1.25
PTN	0.0256	47.2419	0.14
RBN	0.0233	12.4066	0.43
BEV	0.0228	13.2299	0.79
POL	0.0224	7.9530	0.64
FDW	0.0209	1.9729	2.89
FVG	0.0200	20.7630	0.30
SPC	0.0176	19.6044	0.24
FOR	0.0168	5.0203	0.77
SUG	0.0160	20.3194	0.18
OCE	0.0145	14.2361	0.32
FIS	0.0137	3.7067	1.02
BRE	0.0137	9.5707	0.40
CAS	0.0135	39.3553	0.09
OFT	0.0119	16.5314	0.25
OMT	0.0107	2.2902	1.04
EGG	0.0092	30.6472	0.07
ALC	0.0089	1.3867	7.00
ORT	0.0081	24.3326	0.14
OMK	0.0075	1.9638	1.29
BAN	0.0067	15.6197	0.11
CHE	0.0052	0.8674	1.31
OLG	0.0044	3.5431	0.34
CVG	0.0025	1.0745	1.01
POT	0.0023	3.5716	0.15
NUT	0.0019	3.8800	0.20
OBK	0.0019	0.2641	5.09

respective commodity (see Table 4.1) to obtain the price, income, and family size elasticities in the diagonal and the upper off diagonal part of the price elasticity matrix.

The Full Matrix of Demand Elasticities

The calculated elasticity matrix (Table 4.2) had 900 price elasticities plus 30 income elasticities for the 30 food groups, 32 price elasticities plus one income elasticity for the all-food aggregate, and 32 price elasticities plus one income elasticity for the nonfood group, for a total of 996 prices and income elasticities. The 32 groups and their variable names were given in Figure 3.1. The 30 family-size elasticities will be discussed in a separate section.

Applying the general restrictions of the consumer theory, only 495 elasticities or

$$(n^2 + n) - ((n^2 + n + 2)/2)$$

where n is equal to 31 (30 food groups plus one nonfood group) were calculated directly making use of the estimated regression coefficients. The rest were derived as explained in Chapter III.

All the coefficients presented in the elasticity matrix in Table 4.2 were the result of the applied

Table 4.[illegible] Elasticity matrix for food and nonfood commodities

	RIC	FAT	BEF	FMK	PTN	RBH	BEV
RIC	-.468678	.0150386	-.121812	-.224391	-.048324	.0764311	.0090591
FAT	.0013273	-1.37831	.0399466	-.021191	.0139341	-.1068585	-.010728
BEF	-.391032	.0125062	-1.70453	.3880998	.2422791	.4621812	.0178289
FMK	-.704585	-.072877	.4695052	-1.73966	.0900230	.1765227	-.041158
PTN	-.190008	.0053786	.3057456	.0962717	-1.62926	.4988961	-.035854
RBH	.2329542	.2348904	.6392313	.2171300	.5644442	-1.28724	.0110183
BEV	-.001672	-.029456	.0519074	-.032684	-.032460	.0032815	-.774118
POL	-.079073	.0521671	-.210296	-.017451	-.260845	.1398433	-.141376
FDW	-.654877	-.489411	-.397863	-.119285	-.193705	-.197665	-.133329
FVG	.1568708	.0777268	.1764044	-.038167	-.054107	.0351349	-.130922
SPC	-.249605	.0030094	.2962188	.1424885	-.022344	-.132987	.0255896
FOR	-1.20349	-.345123	.5886421	.3979459	-.513988	-.424806	.0943125
SUG	-1.02641	-.449872	.7938838	.2092158	.1700612	-.476323	.2366396
OCE	.2106366	.0198445	-.021178	.2769948	-.345445	-.003008	.0291195
FIS	-.050510	.0570831	.3696716	.3022375	-.136728	.0887535	.0381152
B&E	-.089414	-.022468	-.106919	-.131639	.0052685	.0421889	-.003413
CAS	-.408111	-.419758	.8980362	.5091213	.5273834	-.239844	-.159968
OFT	-.504434	-.196100	.0771819	.0442710	-.377728	-.069468	-.059093
ONT	-.621277	.1314742	.6459895	-.025551	-.520553	-.518326	-.169390
EGG	.4077358	.4468458	1.595364	-.401805	-.099060	.4926736	.0705563
ALC	-.521719	-.680581	.0814897	-.096825	-.211606	-.114294	-.585757
ORT	-.574183	-.073812	.2093247	.5150462	-.324768	-.195358	.1239140
OHK	.0178859	-.239138	-.415884	.5440894	-.378302	.0174882	-.206603
BAN	-.147908	-.402379	1.614299	.4270427	-.263817	-.107713	-.159442
CHE	.1107597	-1.39507	-2.17848	-1.23576	-1.83773	-.924305	1.762128
OLG	-.086048	1.646997	4.586968	3.544175	-.790643	.0617824	-.067967
CVG	.5123973	1.360553	-.688218	.0240597	1.325407	.8188891	-.039534
POT	4.905634	4.761158	-2.64277	-.341124	5.547962	1.557051	-.425352
NUT	-1.73880	2.475488	1.651586	.6731463	-2.51944	-1.45126	-.245286
OBK	-.406834	.0247874	1.607111	-.062502	-.639433	.1291453	-.068498
ALL	-.263497	-.154201	.1014618	-.009737	-.125762	-.025405	-.048393
VCN	-.008912	.0328441	-.038649	.3928913	.0272895	.1391381	.0378603

Table 4.2 Continued

	POL	FOW	FVG	SPC	POR	SUG	[illegible]
RIC	-.002116	-.074839	.0494663	-.054681	-.257391	-.222879	[illegible]
FAT	.0356898	-.101656	.0323500	.0015989	-.102426	-.146714	[illegible]
BEF	-.163877	-.189692	.0956791	.1536741	.3143862	.3959892	[illegible]
FMX	-.014336	-.003545	-.042133	.0862794	.2557309	.1182323	[illegible]
FTN	-.222641	-.060000	-.050174	-.022455	-.329182	.0979250	[illegible]
REN	.1551674	-.065610	.0349733	-.096038	-.287113	-.325544	[illegible]
BEV	-.126207	-.017574	-.116448	.0179215	.0835985	.162503	[illegible]
POL	-1.72640	-.135949	-.091148	.1170500	.3168737	.0436199	-.007318
FDW	-.245214	-6.84919	-.584827	-.196007	2.618950	1.893060	-.129860
FVG	-.087874	-.506591	-1.30310	-.027915	.1904397	.1900881	-.049925
SPC	.1646086	-.126602	-.031611	-.587362	-.121687	-.038109	.0121044
POR	.4155245	3.342844	.2071881	-.143399	-3.18503	-.073182	-.368103
SUG	.0793315	2.582815	.2394031	-.037401	-.059087	-.457666	-.067468
OCE	.0023722	-.082038	-.069930	.0135673	-.413074	-.077615	-2.40712
FIS	.0025184	.7293255	-.038098	-.040031	-.206233	-.004602	.0039534
BRE	.1070434	.0679063	.0638405	-.013524	-.125610	-.063524	.0366223
CAS	.6314724	1.597905	-.258842	-.066166	-1.00354	-.198893	-.426279
CFT	-.001350	.7512477	-.043646	-.007968	-.481341	-.104555	-.408852
OMT	-.821357	3.554726	.2976448	-.127213	-.339475	-.087508	-.168115
EGG	-.6032040	-.030757	-.061632	.2897114	1.274996	.0019316	-.338014
ALC	-.486680	.6810031	-.293090	-.263621	-.461080	-.150489	-.134547
OMY	-.408086	2.314882	-.135975	.0159748	.0363135	-.025087	-.0914517
OMK	-.364127	-1.10712	-.025113	-.212570	-.008441	-.142061	-.191409
RAN	.5122470	.6602959	-.0325937	.2311630	-.208516	-.098515	-.316049
CHE	-.414248	7.714869	-.3230960	-.285560	-1.74674	.0702598	-.280436
CLG	.7914259	-1.02578	.8370777	-.523126	1.409225	-.200454	.2520830
CVG	-.6067594	1.519959	-.812643	-.229105	1.140329	.1418944	.4111551
POT	-.683898	-20.2892	2.747935	.7909645	6.325170	.1229049	1.214449
NUT	-1.34475	5.218851	-.188226	-.436674	1.106062	-.510088	.5771732
OBK	-.400466	-6.51834	-.006274	-.059811	-.203133	-.245502	-.360782
ALL	-.000387	.0160301	-.052093	-.040872	-.023864	.0271916	-.117495
NON	.0387742	.2331353	.0200807	.0210751	.0724059	-.016122	.0031538

Table 4[illegible] Contir[illegible]

```
          ---FIS------SRE------CAS-----[illegible]-----OMT-----[illegible]----[illegible]
RIC       -.001616 -.007526 -.074492 -[illegible] -.070040 .0593708 .02[illegible]
FAT       .0198739 -9.44E-4 -.118365 -[illegible] .3471208 .0880397 -.03[illegible]
BEF       .1563478 -.057491 .3831360 .028797 .2354929 .4777240 .052[illegible]
FMK       .1557346 -.073793 .2557332 .0230068 5.946E-4 -.143623 .0451657
PTN       -.075092 .0022014 .2695404 -.170116 -.204217 -.033944 .0072965
REN       .0589122 .0329744 -.138741 -.022037 -.216772 .2008286 .0428401
BEV       .0249889 .0014891 -.093004 -.021459 -.060726 .0325475 -.144362
POL       -.004162 .0609455 .3676344 .0018735 -.381390 .2450016 -.114095
FDW       .4104132 -.020528 .9546401 .3776693 1.783323 -.054995 .3189737
FVG       -.022656 .0486153 -.177951 -.015495 .1778163 -.023128 -.046082
SPC       -.027642 -.005601 -.053911 .0052233 -.059538 .1560619 -.048841
POR       -.176821 -.109873 -.820205 -.341312 .2842243 .6896559 -.166921
SUG       .0013140 -.047590 -.168976 -.065681 -.039150 .0074913 -.020138
OCE       .0063922 .0386272 -.401030 -.326501 -.105485 -.208884 .0012925
FIS       -2.26643 .0869737 .0767535 .0886758 .0220144 .3681472 -.003480
SRE       .0861989 -1.65064 .7229140 .1832851 -.148714 .1104829 -.022381
CAS       .0844492 .7405521 -2.46890 -.167235 -.158218 -.817234 -.052326
CFT       .1047978 .2213606 -.204471 -1.91782 -.003749 -.533802 -.304935
CMT       .0035992 -.207905 -.225103 -.013667 -5.54957 1.011021 -.070650
EGG       .5461401 .1623003 -1.21607 -.691475 1.195802 -.896023 -.034385
ALC       -.131739 -.159447 -.210890 -.512510 -.169077 -.117199 -9.00935
ORT       -.309221 .3689959 .1517886 -.003153 .2702793 -.058410 1.631070
OHM       -.079549 -.014837 -.066880 -.527333 -.123997 -.106480 -1.11082
SAN       -.678602 .3803565 .3286830 .3250292 -.488552 -.166960 -.061887
CHE       -.115647 -.459627 -.531897 -.166492 .4436546 -.404729 2.087747
OLG       2.553686 2.041350 -3.02329 -.8955413 3.287324 .2483070 8.316117
CYG       .0083157 .3797364 .2558534 -.706085 -.172108 .1193439 -6.11157
POT       1.435144 -1.53408 2.076496 -2.96326 .6919679 .4707087 -2.27388
NUT       -5.60772 1.095851 2.512835 -.826205 -1.17740 -.141964 -3.61483
ORK       -.211846 .1436658 -.387002 -1.46915 .4510727 -.150557 -4.13735
ALL       -.028171 -.00531 -.068436 -.116379 -.02553 .0590306 -.137937
NCM       .0287064 .861019 -.001164 .0154369 .0446424 -.003225 .0972331
```

Table [illegible] Continued

	ONT			CHE			
RIC	-.062313	[illegible]	[illegible]	.0323858	[illegible]	[illegible]	[illegible]
FAT	-.012758	-.014055	-.053591	-.124810	.1508645	[illegible]	[illegible]
BEF	.0470362	-.090332	.3507754	-.355727	.6575116	[illegible]	[illegible]
PMK	.1570338	.1742324	.1080805	-.229946	.6093731	[illegible]	[illegible]
PTN	-.107195	-.093487	-.070486	-.351804	-.136503	[illegible]	[illegible]
RBN	-.064835	.0277433	-.028138	-.181702	.0187180	[illegible]	[illegible]
BEV	.0425854	-.048315	-.046259	.4230644	-.011716	[illegible]	[illegible]
POL	-.154080	-.106350	.1493774	-.076449	.1550114	[illegible]	[illegible]
POW	.8570169	-.414417	-.1780637	1.904078	-.237570	[illegible]	[illegible]
FVG	-.056182	.0108510	.0120647	.1070317	.1875307	-.098089	[illegible]
SPC	.0066465	-.070352	.0831739	-.061491	-.129822	-.029519	[illegible]
POR	.0092026	.0093420	-.087923	-.520344	.4733354	.1682160	[illegible]
SUG	-.012456	-.045208	-.039130	.0462464	-.052900	.0250253	[illegible]
OCE	.0500558	-.079165	-.145166	-.081645	.0788311	.0728992	.1920321
FIS	-.196610	-.036151	-.332374	-.022365	.8268338	.0036421	[illegible]
BRE	.2156893	.0094873	.1848034	-.151901	.5608601	.070653	[illegible]
CAS	.0925466	-.015106	.1655990	-.180459	-.988304	.0502906	.3550703
GFT	-.010144	-.317904	.1775954	-.054260	.3304197	-.146134	[illegible]
OMT	.1906417	-.083226	-.315087	.2269360	1.352089	-.041176	.1448370
EGG	-.057239	-.071129	-.124661	-.209585	.1170743	.0336725	.117110
ALC	1.417580	-.989746	-.109034	1.195267	4.110202	-1.72782	-.769303
ONT	-2.33373	-.251440	-.331321	-.250602	.0938124	-.118438	-.3969480
OMK	-.295547	-5.20549	1.012308	.0646695	-.309854	-.194263	-.689520
BAM	-.404852	1.153188	-3.70049	.3306530	-1.70372	-.181111	.2261567
CHE	-.429190	.0807426	.3580063	-5.76217	2.681870	-.332943	-.783130
OLG	.1680809	-.507711	-2.57713	3.165181	-7.25628	.1904332	-.408211
C/C	-.398642	-.575928	-.495484	-.680496	.3193484	.7426848	-1.57164
POT	1.359601	-2.22046	.6578235	-1.73918	-.934774	-1.66530	-.475924
NUT	-.643160	1.281608	.1693147	1.379173	-2.84034	-6.35253	-1.75816
OBK	-.481366	-4.75277	-.749203	-.180294	-.524247	-.254463	-.075981
ALL	.0029225	-.153847	-.043972	-.01383	.1440205	-.037763	-.027783
NON	-.015717	.0233134	.0032229	.03806	.0005787	.0033905	-.000193

Table [illegible] Concluded

	[illegible]T	GBK	[illegible] OOD	NON [illegible]OOD	[illegible]
RIC	-.045119	-.003569	-1.30598	.1885992	.2464375
FAT	.0961801	.0074558	-1.21402	.4408520	.5352034
BEF	.1017460	.1052350	1.501769	-1.06439	1.598464
FMK	.0485129	6.166E-4	-.161558	7.418284	1.198487
PTN	-.188523	-.041770	-2.30136	.4213434	.9696628
HGN	-.118389	.0174181	-.101468	3.196350	.3243274
BEV	-.020869	5.442E-4	-.766214	.8697111	.6663845
POL	-.115667	-.028731	-2.00511	.6177352	1.238625
FDW	.4652566	-.594711	-1.82417	3.107433	5.669399
FVG	-.018172	.0058325	-.562248	.5916515	.5693156
SPC	-.047545	-2.55E-5	-.817862	.8905149	.5847457
POR	.1232190	-.018246	-.830175	1.804281	1.497870
SUG	-.061700	-.022427	1.255585	-.349708	.4390878
OCE	.0755865	-.040968	-3.73928	.1679450	.6276950
FIS	-.781780	-.023471	-.813257	1.011188	.8223554
BRE	.1523711	.0257034	-.029459	31.39321	.9248112
CAS	.3550119	-.047577	-2.07493	.1619863	.3361097
CFT	-.133957	-.228291	-4.97955	.2924275	1.456156
OMT	-.212780	.0831820	-1.68737	1.332207	2.247922
EGG	-.030828	-.025878	3.066789	-.366595	1.130409
ALC	-.795114	-.857658	-12.1737	.8261623	10.05747
OBT	-.150757	-.105821	.5699425	-.830107	.4731143
OMK	.3204962	-1.20296	-11.2678	.2906487	3.274978
BAN	.0477090	-.206575	-3.02762	.2442520	.7395020
CHE	.4979151	-.067903	-3.18660	1.557967	4.964628
OLG	-1.22408	-.219353	16.39067	-.060932	.9987187
CVG	-4.88981	-.180790	-7.83437	.2150543	1.684815
FOT	-1.47873	-.055998	-5.63910	.0867209	.4890273
NUT	-1.35568	-.047835	-14.6953	.0316775	.4655107
DRK	-.054649	-6.99516	-27.0397	.1462476	3.954494
ALL	-.057541	-.097627	-1.41957	.1655520	1.254023
NCN	-.000414	.0066454	.4192827	-2.80366	.7461540

methodology. Some of these coefficients [illegible] logical range, however they were not [illegible] in George and King (1971, p. 39) or [illegible] Heesen and Johnson (1976, p. 41). This was [illegible] not to obscure the results obtained [illegible] and methods used.

As indicated earlier, the results of the estimation procedure were affected by the ordering of the commodity groups. The groups were arrayed in a descending order by the budget shares. As a consequence, any error build-up associated with the procedure will fall on those food groups that are least important in household budgets. Elasticity coefficients associated with these minor items in the budget are the ones closer to the bottom of the matrix. Problems with errors build-up were by and large associated with estimated coefficients corresponding to commodity groups with an expenditure proportion equal to or less than .006 (see Table 4.1). These are cheese, other dried legumes, canned-vegetables-and-soups, potatoes, nuts-and-other-oily-seeds, and other bakery products. All of them together represent 1.8 percent of the average total expenditures of households in the sample.

Looking at the matrix in general, it can be observed that most of the coefficients have a negative sign. For the own price elasticity this result was expected. For the cross price elasticities a negative sign means that the commodities are complements. Many of these commodities with negative cross price elasticities were expected to be substitute or independent groups. In many cases the unexpected negative sign can be explained because of the general substitution effect. Even though two goods i and j were independent, a change in the price of j does not leave the demand for i unaffected because there is an overall effect due to the fact that all goods compete for the consumers' income (See Philips, 1974, p. 63). In a complete demand system this fact becomes obvious.

Observing closer the results for own price elasticities, the inelastic commodities, those with own price elasticities greater than -1, were rice (-0.47), non-alcoholic beverages (-0.77), spices and miscellaneous (-0.57), sugar (-0.46), eggs (-0.90), and potatoes (-0.48). The expenditure on those commodities will increase if their prices increase. Ten commodities were in the elastic range of -1 to -2, and include fat-and-oils (-1.38), beef (-1.70), fresh milk (-1.74), plantain (-1.63), red beans (-1.29), poultry (-1.73), fresh vegetables (-1.30), bread (-1.65), other fruits (-1.92) and nuts-and- oily-seeds (-1.36). Seven commodities had own price elasticities less than -2. These coefficients seem too high in absolute value and included food away from home, alcoholic beverages, other-milk-and-milk-products, cheese, other dried legumes, and other bakery products.

Price elasticities for beef and pork were estimated by the USDA (1978) for Mexico and Central America. The own price elasticity of the demand for beef was estimated to be -0.4, elasticity of the demand with respect to the price of pork, 0.1, income elasticity of beef, 0.7, own price elasticity of the demand for pork, -0.3, elasticity of the demand for pork with respect to the price of beef, 0.1, and income elasticity of pork, 0.6.

The signs were consistent, but in each case the absolute values of the elasticities in this study were larger (by factors of 2.3 to 10.7) than the USDA estimates for Mexico and Central America. Also, in this study, some of the cross price elasticities were excessively high--for example, potatoes, other dried legumes, canned vegetables, nuts-and-oily-seeds, and other bakery products. Also the elasticities showing the effect of the price of food away from home on the consumption of several commodities were believed to be too high.

In general, the estimated cross and direct price elasticities for most of the commodities were within a logical range. For instance, on consulting the elasticities table it follows that for a 10 percent increase in the price of rice the consumption of rice will decrease by 4.7

percent. The cross price elasticity of beef with respect to the price of rice (row 3, column 1) shows that for the same increase of 10 percent in the price of rice the consumption of beef was reduced by 3.9 percent. Also a 10 percent increase in the price of nonfood decreased the consumption of rice by 1.9 percent. An increase of 10 percent in income increased the consumption of rice by 2.5 percent, and so on.

All-food has an estimated income elasticity of 1.3 which is reasonable for the country. The average total expenditure level was $220 per month, of which 50 percent was spent on food. For comparison Dal Rosario and Musgrove (1980) estimated expenditure elasticities for the food, beverages, and tobacco group of 1.6, 1.0, 0.6, and 0.5 for expenditure levels of $100, $200, $400, and $800 respectively. The estimated income elasticity for food was greater than the nonfood income elasticity. This result is reasonable in a country with a low total expenditure per household and implies that with a given increase in income, the consumption of food will increase more than the consumption of nonfood items. This result has implications for the nutritional policy discussed in the next chapter.

The income elasticities for alcoholic beverages and food away from home are probably too high. The problem might be related to their high price/weight ratio since these elasticities are the result of dividing the coefficient for total expenditures from the regression equation, b_i, by the mean quantity consumed measured in pounds per month.

Most of the income elasticities are within a logical range. For comparison FAO (1971) estimated income elasticities for the Dominican Republic for rice (0.60), starchy roots (0.29), sugar and sugar products (0.60), oilseeds (0.50), vegetables (0.40), fruits (0.29), beef and veal (0.80), poultry (1.0), pig meat (0.70), eggs (1.0), fish (0.60), milk (0.70), cheese (1.0), and fat and oils (0.69).

The own price elasticity of all-food was -1.4. As indicated before, this estimated elasticity was obtained by summing the price elasticities of all-food with respect to each food group, e_{ij}. One would expect the absolute value of this elasticity to be lower. However, in comparison with the own price elasticity for nonfood (-2.8), all-food was more inelastic than nonfood, as was expected.

Further interpretation of this table may be interesting for specific commodities and in general, cross price elasticities in a demand system are important. The usefulness of this matrix and some implications for policy analysis will be discussed in the next chapter.

The Family-Size Elasticities

A family-size elasticity may be interpreted as the percentage change in the consumption of a good as the result of a 1 percent change in the size of the family. Most of the elasticities were positive and within a range of 0 to 1 (Table 4.3). This implies that the demand for those goods will increase when the family size increases, but in a smaller percentage. The commodities with a negative elasticity, as indicated earlier, were beef, food away from home, other fruits, other meats, alcohol, other milks and milk products, cheese, and other bakery products. Except for other fruits, all were most expensive products (see Table 4.1) and can be considered as "luxury" foods.

The New Method of Estimating Engel Elasticites

The results of the new method of estimating Engel elasticities were applied to the consumption of rice. The estimated values of the elasticities were disappointing and excessively high. The results are presented in Appendix A. Estimated expenditure elasticities used in the policy analysis were the ones obtained from the elasticity matrix. These coefficients are consistent with the price elasticities since they belong to the same demand system.

The elasticities obtained using the new method which was described in the theoretical framework section though

Table 4.5 Estimated family [illegible]

	FAM.SIZE
RIC	.5728634
FAT	.1864453
BEF	-.150928
PAK	.0938988
FTN	.1399309
RBW	.4891751
BEV	.1264484
POL	.0058217
FDM	-1.98352
FVG	.1371189
SPC	.1010487
POB	.0600737
SUG	.2340128
OCE	.2897583
FIS	.1296042
BRE	.3040831
CAS	.7693878
OFT	-.176509
OMT	-.394077
EGG	.0015564
ALC	-4.05590
ORT	.8337375
OLK	-1.38754
BAR	.6814984
CHE	-1.87372
OLC	.4978635
CYC	2.206377
POT	.7955863
JUT	.7251987
CBX	-.100358

seemingly overestimated were logical in relationship to total expenditures. The elasticities for rice increased as total expenditures increased up to $200 per month where they reached the maximum. At total expenditure level over $200 the expenditure elasticities for rice began to decrease.

CHAPTER [illegible]

IMPLICATIONS FOR POLICY

The data used in this research recorded the amount and the value of food items purchased by sampled households. In order to derive nutritional implications, it was assumed that the food purchased was consumed by the household. In the Dominican Republic this assumption is close to reality, especially for low-income households. Since the data do not provide knowledge of the distribution of food among family members, it was further assumed that food was distributed in proportion to the needs of each household member.

Using the results of the elasticity matrix, the nutritional implications of the demand system were analyzed from the point of view of the potential impact of income changes on calories and protein intake. Income and price elasticities were used to analyze how a change in income affected nutrient intake.

Before going further it is necessary to clarify the meaning of nutrition as this concept is used in this study. To analyze nutritional policies, some indicator about nutrition has to be used. But to choose an indicator is a controversial matter. In this study the indicators were determined by the kinds of data available to be calories and protein intake per person per day. These are flow measurements, but are also commonly taken as shorthand indicators of current or likely future nutritional status (Dowler et al., 1982, p. 103). Indicators of state are also commonly used. These indicators are based on anthropometry or on biochemical nutrition parameters. For a discussion of state indicators see Mousele (1981, p. 10), and Davis (1982).

The Effect of Changes in Prices on the Calorie and Protein Intake

Following the method described in chapter IV, the change in calorie and protein intake as the result of a change in the price of a commodity was estimated. The estimates were based on consumption per capita per day of each commodity, the price elasticities (Table 4.2), and the calorie and protein contents of each commodity (Table 5.1).

The estimated effect of a 10 percent increase in the price of rice on calorie and protein intake was a reduction of 70 calories and 0.8 grams of protein in the overall per capita intake per day (Table 5.2). It should be pointed out that such estimates based on discrete changes can only be approximated by the point elasticities given in Table 4.2 since point elasticities are based on infinitesimal changes.

Table 5.1: Calorie and protein i[illegible] portion by food commodity group

Commodity	Calories	grams of protein
RIC	1645	33.0
FAT	3676	0.9
BEF	1107	84.8
FMK	277	15.9
PTN	597	5.4
BHN	1526	99.0
BEC	843	18.0
POL	771	84.0
FDW	--	--
FVG	222	2.5
SPC	590	5.4
POR	980	70.0
SUG	1678	0.9
OCE	1674	47.9
FIS	453	94.0
BRE	1424	46.7
CAS	598	4.5
OFT	295	3.7
OMT	907	80.0
EGG	671	51.3
ALC	616	--
ORT	526	7.9
OMK	1002	27.2
BAN	498	5.4
CHE	1007	108.9
OLG	1526	102.1
CVG	216	8.5
POT	412	13.7
NUT	1896	52.8
OBK	1769	33.0

Source: Calculated by the author based on average for the groups from information about the food composition for single commodities from INCAP-ICNND, 1961, Whitney and Hamilton, 1977, and ONAPLAN, 1980b.

Table [illegible] rice on [illegible]

Commodity	Change in [illegible] intake	[illegible] in gms. [illegible] intake
RIC	-29.90	[illegible]
FAT	0.04	--
BEF	-2.38	[illegible]
FMK	-0.56	[illegible]
PTN	-3.32	[illegible]
RBN	2.73	[illegible]
BEV	-.01	[illegible]
POL	-0.32	[illegible]
FDW	--	--
FVG	-0.47	[illegible]
FOR	-3.75	[illegible]
SUG	-22.43	[illegible]
OCE	3.06	[illegible]
FIS	-0.05	[illegible]
BRE	-0.76	-0.025
CAS	-5.64	-0.042
OFT	-1.57	-0.020
OMT	-0.83	-0.073
EGG	5.48	0.419
ALC	-0.33	--
ORT	-4.32	-0.065
OMK	-0.02	-0.001
BAN	-0.71	-0.008
CHE	0.07	0.007
OLG	-0.34	-0.023
CVG	0.09	0.003
POT	4.95	0.164
NUT	-7.95	-0.211
OBK	-0.12	-0.002
ALL	-70.25	[illegible]

Source: Calculated from the information given in [illegible] and 5.1.

Also, estimates based on finite changes would be most accurate when the changes are near the average prices observed in the data. Finally, the estimates assume ceteris paribus conditions, i.e. only the price of rice changes. The major reduction in calories was due to the drop in the consumption of rice (RIC) wich accounted for a reduction of 29.9 calories. This was followed by a reduction of 22.4 calories due to the decrease in the consumption of sugar (SUG). However, there were some gains in calorie intake as the price of rice was increased. For instance, eggs (EGG) contributed with 5.5 calories, potatoes (POT) with 4.8 and other cereals (OCE) with 3.1 calories.

The drop in rice (RIC) consumption as a result of the price increase was mainly responsible for the reduction in protein intake--accounting for 0.60 grams of it. Pork (POR), beef (BEF), and nuts and oily seeds (NUT) caused reductions of 0.27, 0.15, and 0.22 grams of protein respectively. Major gains in protein intake came from an increase in the consumption of eggs (EGG), potatoes (POT) and red beans (BEN), which accounted for 0.42, 0.16, and 0.15 respectively. However, the increase in the consumption of red beans was not expected since rice and red beans are consumed together and considered to be complements in the Dominican diet. The results suggest that the proportions of rice and red beans used in the diet are responsive to relative price changes.

These results provide an example of how the estimated elasticities (Table 4.2) may be used to measure the effect of an increase in the price of a commodity on the intake of calories and protein in the Dominican Republic. Such measures can provide useful insight into how a change in price of a commodity can affect nutritional goals for persons concerned with food price and nutritional policies. The same analysis could be done for each commodity or group of commodities included in the elasticity matrix.

The Effect of Changes in Income on the Calorie and Protein Intake

The effect of an increase of 10 percent in real income was evaluated with the income elasticities given in Table 4.2 to see how such a change affected the overall intake of calories and protein. As can be observed in Table 5.3, the consumption of calories increased by 166 per capita per day. The major increase was due to plantain consumption (PTN) which accounted for 16.9 calories, followed closely by rice consumption (RIC) which contributed 15.7 and by fats and oils (FAT) which contributed 15.2 calories. Conditions on these estimates similar to those given on pages 82 and 85 [illegible] Effect of a 10 percent increase in income on calorie and protein intake per capita per day

Commodity	Change in Calorie Intake	change in gms. of protein intake
RIC	15.72	0.315
FAT	15.51	0.004
BEF	9.75	0.746
FMK	0.95	0.054
FTN	16.92	0.153
RBN	3.80	0.246
BEV	4.84	0.103
POL	4.96	0.540
FDW	--	--
FVG	1.72	0.019
SPC	4.27	0.039
FOR	4.66	0.333
SUG	9.60	0.005
OCE	9.14	0.261
FIS	0.88	0.183
ERE	7.86	0.258
CAS	4.64	0.035
OFT	4.52	0.057
OMT	2.99	0.264
EGG	15.19	1.162
ALC	6.29	--
ORT	3.56	0.053
OMK	4.11	0.112
EAN	3.53	0.038
CHE	2.97	0.322
OLG	3.91	0.262
CVG	0.28	0.011
POT	0.49	0.016
NUT	2.13	0.059
OBK	1.17	0.022
ALL	166.38	5.675

Source Calculated from the information given in Tables 4.2 and 5.1.

are needed Furthermore here any problem on the food supply side are ignored. With a fixed supply of food an increase in incomes would simple lead to faster inflation. It is assumed here that the change is in real and not in nominal income.

The cross-sectional survey data used in the analysis had greater variation among households than did the price data. As a consequence, the estimates of the income elasticities were generally estimated with the smallest relative standard errors (see t statistics in Appendix 2).

The overall increase in protein was 5 7 grams per capita per day. The main contributions were from egg consumption (EGG, 1.16 grams), beef consumption (BEF, 0.75 grams), and poultry cosumption (POL, 0.54 grams). Rice consumption (RIC) contributed with 0.32 grams. It can be seen that rice (RIC) and eggs (EGG) are of great importance in the supply of both calories and protein to the Dominican population and must be given special consideration in any food policy. The contribution of cheese (CHE) and canned vegetables (CVG) must be taken with caution due to their small share in the consumer budget.

To analyze the impact of income changes on the nutritional deficit at the national level the increase in calories and protein has to be compared with the nutritional needs of the population. ONAPLAN (1980b, p. 20) calculated

The [illegible] consumption of calories and protein per capita per day was 2356 calories and 49.8 grams of protein. The increase of the intake of these nutrients as a result of a 10 percent increase in income would contribute importantly to correcting the calorie and protein deficiencies of the population. These per capita estimates at the national level provide only broad guidelines and say nothing about the distributional effects and the real nutritional status of low income groups of the population. Measures of demand and income elasticities are needed for different income groups by geographic areas to understand the distributional effects of food policies and nutrition. It would also be interesting and informative to obtain biochemical parameters data on the nutritional status of low income groups. Fairness and equity aspects of food policies cannot be ignored if food policies are to encourage political stability. Therefore, distributional aspects are of major concern and deserve serious analysis.

The Effect of a Change in Income and Price on the Consumption and Imports of Selected Food Commodities

This section is concerned with analyzing the impact on consumption and food imports of (1) a 10 percent increase in real income per capita and (2) a 10 percent increase in real income coupled with a 10 percent increase in price. The demand analysis provides some insight into a situation of rising incomes and rising inflation. The change in consumption was compared with the production, consumption, and import goals of the Secretariat of State for Agriculture (SEA) operative plan. The commodities included in the analysis were those which have been imported or exported in recent years and which were included as single commodities in the elasticity matrix. These were rice (RIC), red beans (RBN), and cassava (CAS). Plantain was excluded because it was measured in units and not in weight in SEA's operative plan.

The analysis was done separately for each commodity. The consumption estimates used as a basis to calculate the effect of changes in income and prices were those from SEA's operative plan (Tables 5.4, 5.5, and 5.6). These consumption estimates were lower than those from the "First National Survey on Households Income and Expenditure (SHIE) for 1976-77. These SEA estimates were used in order to unambiguously compare the results of the estimates based on elasticities from Table 4.2 with 1982 goals of the SEA plan.

The SEA rice program proposed a consumption goal of 314 thousand metric tons for 1982 (Table 5.4). This implies a per capita consumption of 0.32 pounds per day. This consumption goal was based on a projected production of 285 thousand metric tons and a stock at the begining of the year

Table [illegible] program from SEA's operative plan

	1980	1981	1982 goal
	in thousand metric tons		
Production	254.5	260.2	285.2
Initial Stock	30.8	34.1	65.8
Exports	--	--	--
Imports	40.6	62.6	--
Supply	325.9	356.9	350.0
Consumption	291.8	292.1	314.3
Final Stock	34.1	64.8	35.7
	in pounds per day		
Consumption per capita	0.316	0.308	0.322
	in $ per pounds		
Price	0.33	0.36	--
	in thousand		
population	5578.2	5731.6	5889.3

Source: Secretaria de Estado de Agricultura (SEA). Plan Operativo 1982. Santo Domingo, Dominican Republic: SEA, 1981; and ONAPLAN. Plan Trienal de Inversiones Publicas, 1980-82. Santo Domingo, Dominican Republic: PLANDES 42, ONAPLAN, 1980.

Table 5.9. Red beans program from SEA's operative plan

Commodity	1980	1981	1982 goal
	in thousand metric tons		
Production	36.6	37.8	45.2
Seeds and Crop Loses	4.4	4.2	5.0
Initial Stock	0.4	2.8	0.3
Exports	--	--	--
Imports	6.6	--	--
Supply	39.2	36.4	40.5
Consumption	36.4	36.1	38.4
Final Stock	2.8	0.3	2.1
	in pounds per day		
Consumption per capita	0.039	0.038	0.040
	in $ per day		
Price	0.63	0.64	--

Source Secretaria de Estado de Agricultura (SEA). Plan Operativo 1982. Santo Domingo, Dominican Republic: SEA, 1981; and ONAPLAN. Plan Trienal de Inversiones Publicas. 1980,82. Santo Domingo, Dominican Republic PLANDES 42, ONAPLAN, 1980a.

Table 5.6. Cassava program from SEA's operative plan

	1980	1981	1982 goal
	in thousand metric tons		
Production	80.9	119.3	134.4
Exports	1.2	3.8	4.4
Imports	--	--	--
Supply	79.7	115.5	130.0
Consumption	79.7	115.5	130.0
	in pounds per day		
Consumption per capita	0.086	0.122	0.133
	in $ per day		
Price	0.28	0.19	--

Source: Secretaria de Estado de Agricultura (SEA). *Plan Operativo 1982.* Santo Domingo, Dominican Republic: SEA, 1981, and ONAPLAN. *Plan Trienal de Inversiones Publicas, 1980-82.* Santo Domingo, Dominican Republic PLANDES 42, ONAPLAN, 1980a.

of 64.8 thousand metric tons. No imports were projected for 1982. Since 1982 was an election year it was more favorable to the government not to promise to import rice. In order to avoid importing in 1982, the commodity was imported in excess in 1981 and stared to be used in 1982. As a consequence, rice imports in 1981 were one and a half times those for 1980, though production was greater and per capita consumption decreased in 1981. At the end of 1981, stocks were almost double both those for 1980 and those projected for 1982.

Rice consumption per capita was projected to increase in 1982 after falling from 1980 to 1981. The price increased by more than 9 percent from 1980 to 1981. No hypothesis was given in the plan to support 1982 consumption goal.

In this study, an alternative projection was proposed and was based on a method using the information provided in the cited operative plan and the price and income elasticities from table 4 2 for the respective commodities. The results are presented in table 5.7. The elasticities allow to make specific hypotheses about the effect of income and price changes. Population growth for 1982 was used and the consumption per capita was the average for 1980 and 1981. In the projection of rice consumption for 1982, a 10 percent increase in total income was first assumed. The

Table 5.[illegible] Alternative consumption estimates for 1982 – applying price and income elasticities for rice, red beans, and cassava to 1981 figures from Secretariat of State for Agriculture (SEA) operative plan

Commodity	1982 consumption, assuming a 10 % increase in income	1982 cosumption, assumming a 10 % increase in income & 10 % increase in price
	in thousand metric tons	
Rice	311.4	297.7
Red Beans	38.9	34.2
Cassava	105.3	100.6
	pounds per capita per day	
Rice	0.319	0.305
Red Beans	0.040	0.035
Cassava	0.108	0.103

Source: Estimated by the author based on data from SEA, 1980, ONAPLAN, 1980a.

result was a consumption of 311 thousand metric tons. This is less than SEA's projected 1982 goal. Assuming a 10 percent increase in income along with 10 percent increase in price, projected rice consumption was 298 thousand metric tons.

SEA's red beans program proposed a consumption goal of 38 thousand metric tons for 1982 (Table 5.5). In 1981 there were no imports and none were projected for 1982. Consumption remained almost the same during 1980 and 1981. To avoid imports in 1982, production was projected to be 20 percent higher than in 1981 during which year it grew by only 3 percent. With the assumption of a 10 percent increase in total income red beans consumption was projected in this study to be 39 thousand metric tons (see Table 5.7) which is almost the same as the goal from the plan. When a 10 percent increase in red bean price was assumed along with a 10 percent increase in income, projected consumption dropped to 34 thousand metric tons.

SEA's cassava program consumption goal was 130 thousand metric tons, or about 13 percent greater than in 1981, and 63 percent greater than in 1980 (Table 5.6). Exports of this commodity were projected to be greater in 1982 than in 1980 and 1981. To fulfill these goals, cassava production was assumed in the SEA plan to increase 13 percent in 1982 with respect to 1981. Between 1980 and 1981 actual growth was estimated to be [illegible] percent. The projected consumptions in this study were 105 thousand metric tons, assuming a 10 percent increase in income, and 101 thousand metric tons, where a 10 percent increase in price was also assumed (Table 5.7). Both estimates are lower than the 1982 consumption goal from SEA's operative plan.

Finally, if the consumption data from SEA's operative plan (Tables 5.4, 5.5, and 5.6) are compared with the consumption data from SHIE for 1976-77 (Table 5.8) it is observed that the consumption level from the plan is lower in absolute terms for red beans and cassava. In per capita values, consumption data from the SEA plan are lower for all three commodities analyzed. The alternative projected consumption levels based on elasticities of this study (Table 5.7) are lower than the goals from the SEA plan. This result does not mean, however, that consumption from the SEA plan is overly optimistic. It is possible that data for the base year 1981 as well as that for 1980 was underestimated. The SEA goals were not subjected to technical critique but were developed and justified from a political point of view.

Table 5.8 Consumption from the "First National Survey on Household Income and Expenditure " (SHIE) and the operative plan of the Secretaría de Estado de Agricultura (SEA) for rice, red beans, and cassava

Commodity	1976-77 from SHIE	SEA's 1982 goal
	thousend metric tons	
Rice	309.8	314.3
Red beans	60.1	38.4
Cassava	190.5	130.0
	pounds per capita per day	
Rice	0.361	0.322
Red beans	0.070	0.040
Cassava	0.222	0.133

Source from Tables 5.4, 5.5, and 5.6.

CHAPTER VI

SUMMARY, CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

Summary and Conclusions

The concern of development policy in the Dominican Republic provided the impetus for this study Nutritional and other development issues associated with food such as food consumption projections and the effect of food demand on trade were of major concern. The analysis developed estimates of elasticities of demand for food commodities at a disaggregated level. The primary concern of this study was to develop these estimates and to demonstrate their usefulness in evaluating nutritional and food consumption policies.

Estimates of direct and cross price elasticities were used to study the effect of a change in the price of one commodity on the consumption of that commodity and other goods. Such estimates were also used to analyze the effect of a change in income on the consumption of each commodity or group of commodities included in the study. And through the nutrient characteristics of each commodity, the impact on the nutritional intake of the population of price and income changes were estimated in a partial analysis.

The main feature of this study was the estimation of [illegible] demand equations whose coefficients were used to estimate a full matrix of demand elasticities. The estimation of the demand equations and the calculation of the demand elasticities matrix were from cross-sectional data from a national household consumption survey.

To estimate the demand equations, the tobit estimation model was applied to the semilog forms for each single equation. This estimation model was the most appropriate since it allowed the use of all observations available in the sample--including those which were concentrated at zero.

The estimated elasticities matrix was comprised of 996 price and income elasticities for 30 food commodities and groups of commodities, the all-food aggregate, and one nonfood group. Family size elasticities were also estimated.

In general, the estimated cross and direct price elasticities and the family size elasticities for most of the commodities were within a logical range.

The effects of changes in prices and income on calorie and protein intake were estimated using the elasticities.

An increase of 10 percent in the price of rice, and also in income, were postulated, and the changes in calorie and protein intake were estimated. The results reinforce [illegible] are of great importance in supplying calories and protein to the Dominican population.

For Dominican policymakers, this kind of analysis can provide useful insights into evaluating the effects of changes in prices and income on the nutritional intake of the population. However, broad per capita measures at the national level do not reveal the distributional aspects of nutrition problems and particularly the nutritional status of low-income groups.

Finally, an analysis of the effect of a change in income and prices on the consumption and import goals of the Secretariat of State for Agriculture (SEA) crop programs was undertaken for rice, red beans, and cassava. The conclusions were that in the three cases, the projections of the SEA's operative plan could be improved making use of price and income elasticities. It was also concluded that the established goals were motivated mostly by political criteria rather than by technical consistency.

Limitations of the Study

As pointed out in the section on problem setting and objectives, the study was partial in the sense that it focused mainly on the demand side. The impact on food consumption and imports was based on estimates from SEA's operative plan.

Elasticities were estimated only at the national level. The effects of prices and income on the demand for food for specific income groups of the population were not estimated. Nutritional policies affect specific target groups and estimates are needed for each such group if enlightened policies are to be developed.

There were limitations of the data used. Data from the First National Survey on Household Income and Expenditure (SHIE) was not primarily intended to be used for the evaluation of nutritional policies. Nonetheless the detail on disaggregated commodities consumption, the scope of the sample, and the accuracy of the survey provided a vast amount of data. However information on the actual consumption of food purchased, the distribution of food among family members and other nutritional aspects such as food preparation were not collected. Use of the data in this study was based on the assumptions that foods purchased were actually consumed by the household, and that food was distributed proportionally to each household member. It is doubtful if these assumptions are at great variance with reality in the Dominican Republic.

To estimate the effect of a change in price on calorie and protein intake ceteris paribus conditions were assumed, i.e. only the price of rice was assumed to increase. The effect of the change in price on the supply side was not considered.

Suggestions for Further Research

The present study can be extended, and experiences from this effort will be useful to further improve demand research in the Dominican Republic.

The estimation procedure described in the methodology, and sketched in Table 3.1, can be done in an alternative way including the prices of all the commodities or group of commodities in each equation. This procedure might diminish the specification errors in those demand equations corresponding to commodities with the lower budget shares.

Work can also be extended to analyze the effect of income and price changes on the demand for food commodities by income group and geographical area. Such an effort would require the creation of new data sets for the selected food groups, and the estimation of all demand equations and an elasticities matrix for each income group and area.

The number of nutrients included in the analysis could be extended to be more complete. Also, the nutrient content of the food groups could be estimated as a weighted averages to gain accuracy.

Finally, what happens on the supply side is, of course, quite important to the policy making process and information on the supply response of farmers to price changes is important in assessing the total impact of price policies on the economic system.

APPENDIX 1

COMPOSITION OF FOOD ITEMS

COMPOSITION OF FOOD GROUPS

Rice

Other cereals
  oats
  corn-flakes
  noodles, macarrones, and other pastas
  corn flour
  wheat flour
  corn grain

Bread
  hard crust
  soft
  sandwich and others

Other bakery products
  cakes
  biscuits
  cookies
  crackers (salty)
  crackers (soda)
  crackers (regulars)

Cassava

Potatoes

Other root crops
  sweet potatoes
  cassava bread
  mapuey
  yam
  malanga

Sugar and sugar products
  brown sugar
  white sugar
  confection
  candies
  syrups
  honey

Dried red beans

Other dried legumes
  peas

- chick peas
- pigeon peas
- white beans
- broad beans
- lima beans and other

Nuts, coconut, and oily seeds
- dried coconut
- nuts and seeds (mixed)

Fresh vegetables
- peppers
- garlic
- pumpkin
- eggplant
- onion
- chive
- pigeon peas
- jack beans
- red beans
- lettuce
- okra
- cucumbers
- radishes
- beets
- cabbage
- tomatoes
- carrots
- other fresh vegetables

Canned vegetables and soups
- pigeon peas
- sweet peas
- chick peas
- other canned vegetables
- condensed soup
- vegetable soup
- beef noodle soup
- other soups

Bananas

Plantain

Other Fruits
- avocado
- sugar cane
- coconut (fresh)
- guava
- granadillo

  papaya
  lemons
  sweet limes
  mangoes
  apple
  sour oranges
  oranges
  pineapples
  grapefruit
  grapes
  other fresh fruits
  dried fruits
  dried canned natives
  dried canned imported
  canned fruit juice (imported)
  canned fruit juice (native)

Beef

Pork

Poultry

Other meats
  goat meat
  rabbit
  pig feet
  other fresh meats
  hams
  sausseges
  other preserved and canned meats

Fish and shellfish

Eggs

Fats and oils
  copra oil
  sun flower oil
  peanut oil
  soybean oil
  olive oil
  butter
  margarine
  lard
  other oils

Non-alcoholic beverages
  cocoa
  chocolate

  coffee
  soft drinks
  mabi
  malta
  other beverages

Fresh milk

Other milk and milk products
  evaporated
  condensed
  cream
  other milk products

Cheese

Alcoholic beverages
  beer
  rum
  others

Food away from home

Spices and miscellaneous
  pickles
  blak pepper
  oregano
  coriander
  salt
  tomato sauce
  ketchup
  mayonnaise
  other sauces
  flavors and extracts
  vinegar
  gelatin
  baby food
  olives
  ginger
  other miscellaneous

APPENDIX C

REGRESSION COEFFICIENTS FROM TOBIT MODEL

```
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]   654        [illegible]
[illegible]   59         -4.758
[illegible]   767        4.525
[illegible]   070        -6.438
[illegible]   379        2.977
[illegible]
[illegible]              [illegible]541
[illegible]              [illegible]64
[illegible]
[illegible]              [illegible]015
[illegible]              [illegible]715
[illegible]
[illegible]              [illegible]31
[illegible]              [illegible]67
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
```

[illegible] = EMK

[illegible]

[illegible] RATED [illegible]
[illegible] = BEV

[illegible]

```
[illegible]
[illegible]
[illegible]     [illegible]     [illegible]
   LOGINC       [illegible]     [illegible]
   LOGMEM       [illegible]     [illegible]
  CONSTAN       [illegible]     [illegible]
THE MEAN SQUARED ERR[illegible]
THE MEAN ABSOLUTE ERRO[illegible]
THE PREDICTED PROBABIL[illegible]
THE OBSERVED FREQUENCY [illegible]
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                  REGRESSION COEFFICIENTS, ASSOCIATED STATISTICS
                              DEPENDENT VARIABLE = [illegible]
 VARIABLE      COEFFICIENT             T-STATISTIC
     LFIS        -0.4806                 -24.564
     LOME         0.3208                   1.152
     LCAS         0.2045                   0.454
     LBFT         0.3088                   1.788
     LBMT         0.0814                   0.117
     LEGG         1.3846                   2.854
     L&LC        -0.2104                  -0.284
     LBOT        -0.4417                  -0.447
     LDWK        -0.1348                  -0.564
     LBAN        -1.0322                  -2.030
     LCHE        -0.4029                  -0.098
     LOLS         3.0448                   4.080
     LCYE         0.0135                   0.047
     LPOT         0.8927                   1.388
     LNUT        -2.8978                  -0.505
     LOOK        -0.0878                  -0.440
   LOGINC         3.0488                  14.117
   LOGWEN         0.4884                   1.340
  CONSTANT      -14.1488                  -4.812
 THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS
THE MEAN ABSOLUTE ERROR IS =                0.55575
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.5703
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.6387
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                  [illegible]
                  [illegible]
 [illegible]   [illegible]        [illegible]
   LBSE        [illegible]        [illegible]
   [illegible] [illegible]        [illegible]
   LCPT        [illegible]        [illegible]
   LCHT        [illegible]        [illegible]
   LECT        [illegible]        [illegible]
   [illegible]
THE [illegible]
THE MEAN [illegible]
THE PREDICTED [illegible]
THE OBSERVED [illegible]
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                    REGRESSION COEFFICIENTS  ASSOCIATED [illegible]
                              DEPENDENT VARIABLE - [illegible]
VARIABLE        COEFFICIENT             Z-STATISTIC
  LCHS           -12.1644                 -00.338
  LRTN            10.1170                   2.880
  LOF2            -5.5810                   2.208
  LBR2            -6.2262                  -0.840
  LCGG           -12.1825                  -0.875
  LALC            -2.3583                  -1.023
  LSB2             2.0822                   1.048
  LEMK            -0.5840                  -0.225
  LGRN             0.5172                   1.415
  LCHE            -7.1020                  -0.818
  LOLG           -38.0000                  -0.586
  LCYG             1.9282                   0.722
  LPE2            13.9230                   2.112
  LNUT            17.0710                   4.059
  LEBK            -1.0228                  -0.342
  LWINC           13.2277                   0.538
  LGGMEW          30.2787                  10.022
  CONSTANT      -301.0885                 -11.970
 THE MEAN SQUARED ERROR  USING E(Y) FOR PREDICTED VALUES [illegible]
THE MEAN ABSOLUTE ERROR IS =                  7.89177
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X [illegible]
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.7381
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              REGRESSION COEFFICIENTS, ASSOCIATED T-STATISTICS
                         DEPENDENT VARIABLE = OFT
VARIABLE      COEFFICIENT           T-STATISTIC
   LOFT        -31.7840              -31.738
   LORT         -0.0028               -0.018
   LEGG         -0.0348               -0.017
   LALC         -0.0418               -5.326
   LCRT         -0.1077               -0.181
   LOWK         -0.2854                4.080
   LOAN          2.8888                1.276
   LCHE         -0.0978               -0.211
   LOLC          0.4028                1.637
   LCVG         -2.4188               -1.788
   LECT          0.5116               -2.840
   LAUT         -2.2148               -1.418
   LOSK         -3.7925               -4.748
  LOGINC        24.7723               22.776
  LOGMEN        -2.0188               -1.923
 CONSTANT     -181.4559              -12.841
THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, I
THE MEAN ABSOLUTE ERROR IS =          4.28888
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.5
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.0784
```

```
              [illegible]
                  [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     [illegible]      [illegible]
  [illegible]     -3.5942          [illegible]
  [illegible]     0.0317           [illegible]
        LNUT      -0.4873          [illegible]
        LOBK      0.1905           1.059
      LOGINC      5.1401           26.206
      LOGREN      -0.8028          -3.195
    CONSTANT      -19.7011         -9.977
 THE MEAN SQUARED ERROR  USING EIYI FOR PREDICTED VALUES [illegible]
THE MEAN ABSOLUTE ERROR IS =              0.60973
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X [illegible]
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 5.5847
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                    REGRESSION COEFFICIE T [illegible]
                              DEPENDENT VARIA[illegible]
[illegible]     COEFFICIENT          T-STATIS
[illegible]       -27.4686              [illegible]
[illegible]        -1.3838              [illegible]
[illegible]        -1.7582             -1.831
[illegible]        -[illegible]1799     -1.865
[illegible]        -3.4285             -1.878
[illegible]        -6.4232             -1.461
[illegible]         3.5880              3.066
[illegible]         1.5320              3.740
[illegible]         3[illegible]693     1.066
[illegible]        -0.9449             -0.621
L[illegible]       -0[illegible]931     -0.830
[illegible]GINC     34[illegible]437    31.697
LJ0BBF              0.2477              0.831
CONSTANT          -226[illegible]7621  -15.717
THE MEAN SQUARED ERROR USING CITI FOR PREDICTED VALUES, 1.[illegible]
THE MEAN ABSOLUTE ERROR [illegible]          1.44914
THE PREDICTED PROBABIL[illegible]Y OF Y > LIMIT GIVEN AVERAGE X(I) = 0.7[illegible]
THE OBSERVED FREQUENCY OF Y > LIMIT IS A 0.7298
```

```
                    REGRESSION COEFFICIENTS ASSOCIATED [illegible]
                             DEPENDENT VARIABLE Y [illegible]
VARIABLE        COEFFICIENT              T-STATISTIC
   LBLC            12.4939                 -21.898
   LBRT             1.6898                   1.889
   LBAW            -1.2725                  -1.863
   LBAN            -0.1512                  -0.078
   LCHE             1.8575                   0.941
   LBLG             5.6097                   1.768
   LEVG            -2.3984                  -2.282
   LACT            -1.2489                  -0.885
   LNUT            -1.1828                  -0.892
   LCOK            -1.2848                   1.698
  L[illegible]NC          12.8488                  15.584
  L[illegible]PEN          -5.8248                  -4.253
 CONSTANT         -81.8951                  -8.298
 ROOT MEAN SQUARED ERROR USING EIYI FOR PREDICTED VALUES [illegible]
THE MEAN ABSOLUTE ERROR IS =                 0.4241
[illegible] PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE XI [illegible]
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.1220
```

```
                    [illegible]
                    [illegible]
VARIABLE      [illegible]        [illegible]
   LDAT       [illegible]        [illegible]
   LCAS       [illegible]        [illegible]
   LDAK       [illegible]        [illegible]
   LBAM       [illegible]        [illegible]
   LCHE       [illegible]        [illegible]
   LCLU       [illegible]        [illegible]
   LCVG       [illegible]        [illegible]
   LPOT       [illegible]        [illegible].618
   LNUT       [illegible]        -1.394
   LOEX       [illegible]        1.802
 LOGINC       [illegible]        6.241
 LOGAER       0.[illegible]870   7.284
CONSTANT      221.[illegible]550 10.362
THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS          [illegible]
HE MEAN ABSOLUTE ERROR IS =               4.57774
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I)   [illegible]
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.5565
```

```
                [illegible] COEFFICIENTS AND ASSOCIATED T-STATISTICS
                         DEPENDENT VARIABLE - OMX
 VARIABLE     COEFFICIENT        T-STATISTIC
   LDMK        -10.2227           -25.884
   LPMK          0.1045             3.350
   LBAN          5.9800             1.804
   LCHE          4.1270             0.560
   LOLG         -0.2880            -0.206
   LCVG         -0.3016            -0.414
   LPBT         -1.2541            -4.022
   LAUT          0.4394             0.820
   LMBK         -0.2034            -0. 44
  LOGINC         8.4318            13.554
  LOGREA        -1.7240            -3.842
 CONSTANT      -34.8894            -8.012
THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS =              20.57115
THE MEAN ABSOLUTE ERROR IS =             0.18844
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.1022
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.2339
```

```
              REGRESSION COEFFICIENTS  ASSOCIATED T-STATISTICS
                           DEPENDENT VARIABLE = BAN
 VARIABLE      COEFFICIENT          T-STATISTIC
   LOPP         -57.8885             -12.183
   LOFT         -18.2782              -8.261
   LENC           5.1897               0.698
   LELG         -28.8118              -8.338
   LCVG          -2.8289              -1.188
   LEST           3.5329               0.543
   LPUT           0.7882               0.282
   LCOE          -3.2287              -1.922
  LOGINC         11.5588               8.589
  LOGPER         70.6486               3.983
 CONSTANT      -282.8185             -13.688
THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS =          429.2655
THE MEAN ABSOLUTE ERROR IS =              2.7198
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.3831
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.4271
```

```
             REGRESSION COEFFICIENTS, [illegible]
                      DEPENDENT VARIABLE [illegible]
 VARIABLE      COEFFICIENT       T-STATISTIC
  [illegible]     14.9902          -11.316
     LOLG          2.3283            4.891
     LCVG          0.2680           11.729
     LPCT          0.6703           -1.408
     LNUT          0.4310            0.181
     LGRK          0.0589           -0.516
   LOGINC          4.3064           30.922
   LOGMBR         -1.6083           -0.218
 CONSTANT        -16.0488          -16.763
 THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS =                3.08888
THE MEAN ABSOLUTE ERROR IS =            0.87336
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.6688
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.3865
```

```
              REGRESSION COEFFICIENTS, ASSOCIATED T-STATISTICS
                          DEPENDENT VARIABLE WOLG
 VARIABLE      COEFFICIENT          T-STATISTIC
   LOLG          -25.7100            -14.459
   LCVG            8.6303              6.757
   LFST           -1.7296              0.988
   LNUT           -4.3371             -5.037
   LORK           -1.7772             -1.389
  LOGINC           3.5386              6.284
  LOGMEM           1.7040              1.991
 CONSTANT        -69.8254            -13.092
THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS =              73.77544
THE MEAN ABSOLUTE ERROR IS =                 5.42944
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.2779
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.3022
```

```
                    REGRESSION COEFFICIENTS, ASSOCIATED T-STA
                              DEPENDENT VARIABLE = CVG
 VARIABLE     COEFFICIENT          T-STATISTIC
   LCVG          0.7988               8.077
   LPST         -1.6887              -0.889
   LNUT         -0.2548              -0.648
   LBSK         -0.2488              -0.337
  LOGINC         1.0183               3.238
  LOGPER         3.0885               8.431
 CONSTANT      -37.6233              -7.288
THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES, IS =
THE MEAN ABSOLUTE ERROR IS =               0.12068
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.75
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.3882
```

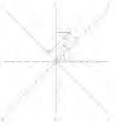
```
                    [illegible]
                         [illegible]
 [illegible]     COEFFICIENT        [illegible]
    LNCT           -1.6998            [illegible]
    LNUT           -6.2814            [illegible]
    LOSS           -6.2088            [illegible]
   LOGINE           1.7448            [illegible]
   LOGNEW           2.8415            2.[illegible]
  CONSTANT        -27.4833           -7.245
 THE MEAN SQUARED ERROR, USING E(Y) FOR PREDICTED VALUES  [illegible]          [illegible]
THE MEAN ABSOLUTE ERROR IS =               0.52871
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I): [illegible]
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.3088
```

```
           [illegible] TS, ASSOCIATED T-STATISTICS
                  [illegible] VARIABLE = NUT
  [illegible]   [illegible]          T-STATISTIC
    [illegible]   [illegible]              15.662
    [illegible]   [illegible]               4.365
    [illegible]   [illegible]               5.675
   L GPLM       [illegible]               2.760
   CONSTANT     [illegible]              -0.434
THE MEAN S[illegible] PREDICTED VALUES, IS =            85.24781
THE MEAN AB[illegible]              0.52875
THE PREDICTED [illegible] GIVEN AVERAGE X(I) = 0.2754
THE OBSERVED [illegible] IS = 0.3422
```

```
               REGRESSION COEFFICIENTS, ASSOCIATED T-STATISTICS
                          DEPENDENT VARIABLE = DBK
    VARIABLE       COEFFICIENT           T-STATISTIC
      LDBK           -1.8471                27.896
     LOGINC           1.2448                12.344
     LOGMEM          -0.0885                -0.198
    CONSTANT         -5.0084               -11.863
 THE MEAN SQUARED ERROR, USING E(T) FOR PREDICTED VALUES, IS =                1.27828
THE MEAN ABSOLUTE ERROR IS =                0.12881
THE PREDICTED PROBABILITY OF Y > LIMIT GIVEN AVERAGE X(I) = 0.1753
THE OBSERVED FREQUENCY OF Y > LIMIT IS = 0.2381
```

APPENDIX [illegible]

ROTATION OF AXES



[illegible] Relationship Between the [illegible] and the x,y Coordinate Systems.

Rotation of Axes: Relationship Between the X,Y and the x,y Coordinate Systems

Assume that the X,Y coordinate system is obtained by rotating the x,y axes through an angle θ about the origin Then any point P in the plane has coordinates (x,y) and (X,Y) in the two systems. If P is not the origin, let ϕ be the angle from the positive X axis to the line segment joining P to the origin, and let r be the length of that line segment, then

$$X = r\cos\phi \quad \text{and} \quad Y = r\sin\phi,$$

using the trigonometric identities for

$$\sin(\theta+\phi) \quad \text{and} \quad \cos(\theta+\phi) \text{ thus}$$

$$x = r\cos(\theta+\phi) = r(\cos\theta\cos\phi - \sin\theta\sin\phi) =$$
$$(\cos\theta)(r\cos\phi) - (\sin\theta)(r\sin\phi), \text{ and}$$
$$x = (\cos\theta)X - (\sin\theta)Y. \text{ Similarly}$$
$$y = r\sin(\theta+\phi) = r(\sin\theta\cos\phi + \cos\theta\sin\phi) =$$
$$(\sin\theta)(r\cos\phi) + (\cos\theta)(r\sin\phi), \text{ thus}$$

$y = (\sin\theta)X + (\cos\theta)Y$. (Robert and Gulick, 1978, p. 640.)

Kakwani and Podder (1976), rotating the coordinate system obtained

$$\eta = (1/\sqrt{2})(F + F_1) \text{ and } \pi = (1/\sqrt{2})(F - F_1).$$

APPENDIX [illegible]

[illegible] NEW METHOD OF ESTIMATING [illegible]

RESULTS FROM THE NEW METHOD OF ESTIMATING ENGEL ELASTICITIES, FOR RICE

Income Class	Elasticity
$ per month per household	
50.00	8.19
100.00	15.12
150.00	23.60
200.00	25.08
300.00	21.51
400.00	5.56
500.00	1.74
600.00	0.78
800.00	0.87
1,000.00	.25
1,500.00	-0.47
2,000.00	-0.01

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BIOGRAPHICAL SKETCH

The author was born on June 4, 1949, in Santo Domingo, Dominican Republic. In 1972 he received the degree of Bachelor of Arts, with honors, in economics, and in 1974 received his Master of Economic Planning, both from the University of Puerto Rico.

During the year 1973 he worked part time at the Puerto Rico Planning Board as an economic consultant. In 1974 he joined the Secretariat of State for Agriculture of the Dominican Republic where he served as an Assistant to the Under-Secretary of Agriculture for Sectoral Planning, as Coordinator of the Sector Analysis Project, as Director of the Division of Agricultural Planning, and as Associate Director of the Department of Statistics and Information.

From 1975 to 1979 the author worked as part time professor in the universities: Universidad Nacional Pedro Henriquez Urena, Universidad Central del Este, and Instituto Tecnologico de Santo Domingo.

In September 1979, the Secretariat of State for Agriculture of the Dominican Republic awarded him a scholarship to pursue a Ph. D. degree in food and resource economics at the University of Florida.

He is married to Nellie and they have three children.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Max R. Langham

Max R. Langham, Chairman
Professor of Food and
Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Woodrow W. McPherson

Woodrow W. McPherson
Graduate Research Professor
of Food and Resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Carlton G. Davis

Carlton G. Davis
Professor of Food and Resource
Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Gustavo A. Antonini
Professor of Latin
American Studies and
Geography

This dissertation was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

April, 1983

Jack L. Fry
Dean, College of Agriculture

Dean for Graduate Studies
and Research